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Organised Generation

The Grid as a National Asset

PROBABLY one of the main causes of the setting up of the British grid system was a realisation during the last war of certain deficiencies in the public supply of electricity. At that time the provision of generating plant to meet the rapidly growing demand was severely handicapped by the need to install sets of varying capacities (with spares) and frequencies suited to the requirements of particular areas.

The lack of flexibility thus apparent led to recognition of the principle that the generation of electricity was too important a national service to be subordinated to purely local requirements, although the merits of individual operation were generally appreciated. A corollary is that during the present hostilities, the most important function of the Central Electricity Board will probably be to arrange for the installation of ample generating plant wherever it may be called for. No doubt economical generation will continue to be an aim, but it will not be the dominant one.

In War and Peace

Such considerations, together with the further one that any area served by a power station that is interconnected with others is unlikely to be left without electricity for a prolonged period due to enemy action, are really uncovenanted mercies, since the grid was not designed primarily with a view to meeting war conditions, but to provide power for industry and the amenities of civilised life.

It was appropriate, therefore, that Mr. Johnstone Wright, in his presidential address to the Institution of Electrical Engineers, should confine his remarks on the war aspect to claiming " that the grid has a vital national rôle in the present struggle." His concern was not so much with the grid as a contribution to our defence measures, however paramount a need this may be in the present emergency, but as a national asset for all time.

One of the most useful features of the address was the frank discussion of troubles that have been encountered, of the steps taken to rectify them and the indication given of the many things that still remain to be done. The address may be said to present another chapter in the tale of the never-ending effort to keep technical accomplishment ahead of the requirements of high-grade electricity supply with all the new problems that quick development raises.

Last week Mr. H. G. A. Stedman, in his chairman's address to the I.E.E. North-Eastern Centre, expressed doubt as to whether development was not getting beyond technique in some respects, quoting examples but at the same time showing the kind of work that is being done to consolidate the position in certain directions.

The presidential address similarly dealt with consolidation as well as advance. It contained plenty of evidence that, unless risks are taken in pressing on with development, loads of the magnitude that the future has in store cannot be dealt with, but that at the same time without continual research and vigilance the quality of the supply will not be good enough to secure or retain those loads.

It is equally clear that the difficulties inherent in progress have stimulated the ideas necessary to provide means for overcoming them, as they should in any healthy body. To quote, as an illustration, one instance given by the President, correct operation of protective gear on the grid as a whole last year reached 88 per cent. While 100 per cent. infallibility is too much to hope for, the fact that in certain areas 96 per cent. was attained (which is about the limit with existing equipment) is certainly an encouraging sign.

Symbol of Co-operation

There was something much more than a mere compliment in the tributes paid by the President to the co-operative spirit in the supply industry, which has contributed so largely to the successful working of the grid, and to the fine engineering of British electrical manufacturers and research organisations typified in the construction of its components. There can be no doubt that the experience gained by our manufacturers in this way has put them in a very strong position for undertaking the largest schemes abroad.

Mr. Wright, as chief engineer to the Central Electricity Board, is accustomed to looking four or five years ahead in planning the country's generating requirements. That habit of mind, implicit in his address, provides an example which if generally followed will be of immense value to the electrical industry, when engineering once more is allowed to serve civilised ends.

Sixty Electrical Years

ENGINEERS have been so busy making history that there has sometimes seemed to be a possibility that the past, with all its rich associations, might go without adequate record, its achievements hidden beneath a mass of more recent technical triumphs and its great names remembered, if at all, as names merely. Individual memoirs of merit there are, but the value of these would be far greater if the events of which they tell could be related to the whole electrical movement. The gap has now been filled by Commander Rollo Appleyard in his "History of the Institution of Electrical Engineers," published this week. The author traces theory and practice, men and methods, set against a background of contemporary events, through the sixty years that followed the foundation of the Institution in 1871 (one year before the ELECTRICAL REVIEW was established), prefacing his narrative with an account of the state of electrical knowledge at that date. The production of the book had reached an advanced stage before the outbreak of war and the decision of the Council of the I.E.E., which commissioned the work, to proceed with its publication will, no doubt, commend itself to our readers.

Stand-by Supplies

IT goes almost without saying that stand-by from public mains should be available wherever practicable for private electric generating plants installed in factories where work of national importance is being carried on. These plants, according to the latest official statistics published, have an effective aggregate capacity about one-third that of the total served by authorised undertakings. It should not be overlooked that approximately the same horse-power is obtained from non-electrical private plant. To give stand-by in such cases would be a more difficult and costly matter, since motors, cable and control gear (which are already there when it is merely a matter of changing over from one source of electricity to another) would have to be provided. In many instances the expenditure will have to be faced to avoid risk of interference with production. The ultimate result will no doubt often be that the original engines will form the stand-by.

Magnet-Wire Insulation

OUTSTANDING among the many exacting requirements of insulation for small conductors wound on coils is that it shall occupy the smallest possible space. Otherwise the effect on the weight and size of the piece of apparatus as a whole may be considerable. In *Electrical Engineering*, the journal of the American Institute of Electrical Engineers, Messrs. W. Patnode, E. J. Flynn and J. A. Weh discuss the application of a new insulating coating called "Formex" to the winding of wires for electro-magnets, the annual production of which they give as 100 million pounds. This coating is a synthetic resin embodying polyvinyl formal. Comparative tests are given in support of the authors' claim that for the purpose mentioned the material is superior to enamel coatings. It is probably too early yet to estimate how far it is likely to be used for insulating fine wires, but the results seem to indicate that synthetic materials may have valuable potentialities.

Marine Regulations

APPROPRIATELY enough at the present time comes the issue of a third edition of the I.E.E. Regulations for the Electrical Equipment of Ships (3s. 3d. in cloth and 2s. 2d. in paper covers from the Institution or from E. F. and N. Spon). While of approximately the same length as the I.E.E. code for buildings, its general layout differs from it considerably. There are also many variations in detail, and the voltages recognised as standard (e.g., 150 V for AC lighting) may surprise landsmen. While the land code is supplementary to statutory regulations made by the Electricity Commissioners, the Home Office and the Mines Department and other public authorities, the marine regulations are designed to cover the production as well as the use of electricity for all purposes in sea-going vessels of every kind except warships. Thus, apart from extensive provisions relating to generation and distribution, there are sections on such matters as radio-interference suppression. Freedom from undue interference, however important it may be in the case of ordinary broadcasting, is essential to safety in navigation.

Export Markets

WE have already referred to the possibilities of the loss of electrical export trade to neutrals who are freer than ourselves just now to concentrate upon this question. The elimination of German trade in overseas markets means that there is more scope, for in some markets, as we showed last week, our enemy was very strong. During the first half of this year the total value of German electrical exports was 156 million Rm., representing all classes of goods from heavy power plant to radio equipment. The latter was a particularly large item. The Latin-American markets figured prominently in the list, although the bulk of the trade was done with European countries. It is worth noting that our contemporary the *Electrical World* has warned American manufacturers not to jump into the export business without prior investigation. That advice applies equally, of course, to British producers who, however, are generally well equipped for the business if certain present obstacles can be got over.

Interior Shop Lighting

AS we have already pointed out, there is a growing tendency on the part of shopkeepers to improve the interior lighting of their premises with a view to counterbalancing the loss of attractiveness of their windows due to the black-out restrictions. This, however, is possible only if the effectiveness of the shop's black-out arrangements is beyond reproach. It is therefore in the interests not only of the shopkeeper but of the electrical industry as well to see that this is achieved. At an exhibition now being held at the Lighting Service Bureau, E.L.M.A. is giving a lead by demonstrating, among other things, how efficient and even attractive light locks can be constructed simply and cheaply. Supply undertakings and electrical contractors should hasten to install these light locks themselves and so be in a strong position to demonstrate them and to encourage what may well be a profitable new branch of business.

Obstacles to Progress

THE Lancashire Electric Power Co. is noted for its advocacy of automatic cooker control. It was therefore not surprising that Mr. O. Howarth, a prominent member of the company's staff, "came out strong" for the system in his address as chairman of the I.E.E. North-Western Centre. He had much to say, too, upon cooker construction, a matter closely related to temperature control, advocating lighter types which could be sold at more economic prices. One thing he proposed was a "three-piece" arrangement, comprising a griller boiler, an electric kettle without feet which could stand upon the griller, and a separate oven. Mr. Howarth was critical of the I.E.E. Regulations for their lack of realism so far as domestic premises were concerned and hoped that they would never become compulsory in their present form. His strictures were based largely on the insistence upon separate sub-circuits for each pair of 15-A plugs which he said militated against adequate wiring by sending up costs. Meter testing requirements (with which he is particularly intimate) also called forth some trenchant criticism.

Infringement of C.M.A. Mark

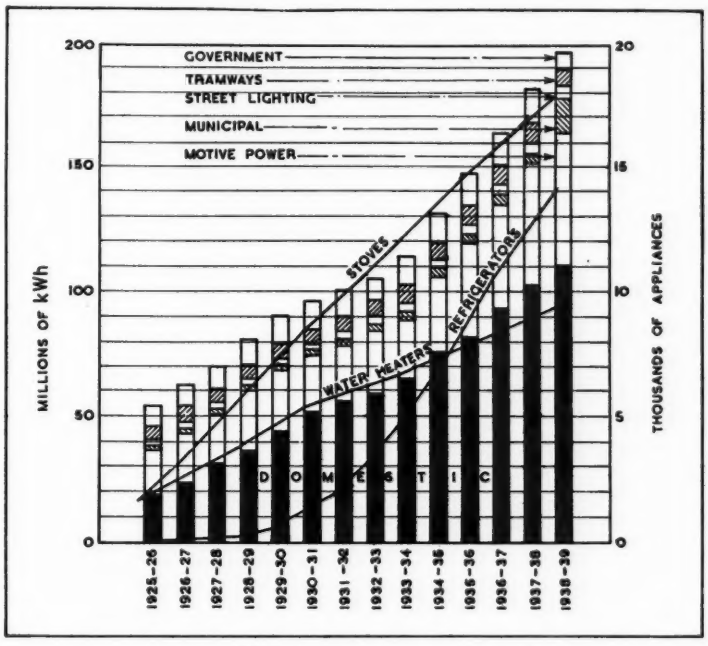
IN our last issue we reported a successful action brought by two members of the Cable Makers' Association against a company who, it was stated, had infringed the C.M.A. trade mark. It is interesting to note that the complaint was not against the use of the mark itself, but against the description of imported cables as "made in accordance with C.M.A. standards."

PROGRESS IN DURBAN

Domestic and Industrial Expansion

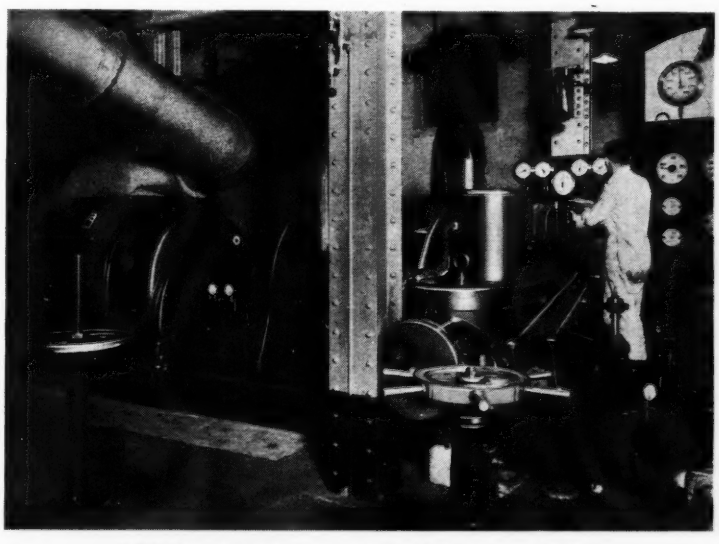
By E. Poole, A.M.I.E.E.

IT is some years since we dealt with the development of the Durban Municipal Electricity Department, since which time many changes have taken place and rapid strides made by the undertaking. The principal event was the virtual closing down of the generating plant of the Alice Street power station in 1927 in favour of a bulk supply from the Congella undertaking of the South African Electricity Supply Commission. Certain of the Alice Street plant, totalling 11,500 kW, is, however, still kept in commission partly for stand-by purposes, but more particularly to take care of the peak load during the winter months. This remaining plant consists of seven B. & W. boilers with an evaporative capacity ranging from 12,000 to 28,000 lb.; one 1,500-kW and two 2,000-kW Parsons steam turbines; and two 3,000-kW B.T.H. impulse turbines generating at 6,600 V, 3-phase, 50 cycles.



Energy sold and domestic apparatus growth

Special mention must be made of a plant from which power is also obtained that has been installed on the premises of one of the largest consumers of the Municipality — the Hulett's S.A. Sugar Refineries, Ltd.— situated in the centre of a large distribution area on the outskirts of the town, the plant being operated jointly by the Municipality and Refinery Co. This plant is unique in its being a waste heat plant, or to be more correct the steam used by the turbo-alternators is exhausted to the factory mains at 15 lb. per sq. in. for the purpose of melting, evaporating and refining the raw brown sugar.



2,000-kW alternator set at Hulett's power station

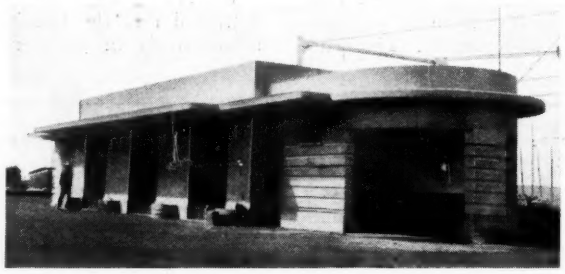
The plant originally consisted of two 1,000-kW Allen-G.E.C. back-pressure steam turbines, operating at 185 lb. pressure and exhausting at 15 lb., run in parallel with both the Commission's and municipal power stations, any surplus power being automatically delivered into the municipal distribution system and alternatively any deficiency due to reduced steam process demands, or failure of generating plant, is drawn from the municipal mains without any interruption whatever in the working of the refinery.

On the operating side the scheme has been an entire success, and is, in fact, remarkably simple. The turbines are set to run slightly off the speed governor and the steam supply is controlled by an "Arca" relay-operated regulating valve. This valve is actuated by compound impulses, one of the overflow type from the high-pressure steam range, and the other of the reducing type from the low-pressure receiver. A drop in pressure in the latter resulting from an increase in the demand causes the reducing impulse to open the regulating valve to pass more steam through the turbines to meet this demand. When the steam quantity passing through the turbines tends to exceed the boiler output, the resulting drop in the steam range pressure acts on the overflow impulse to close the regulating valve, and thus limit the quantity passing through the machines to that which is available from the boilers.

The electrical output varies directly with the process demand, and all the steam up to the capacity of the turbines is usefully employed. This method of control has proved entirely satisfactory, although at first a little trouble was experienced due to the large fluctuations in process demands. Conditions in this respect have recently been improved by the installation of a thermal storage system, and the turbines are now work-

ing under practically steady inlet and exhaust pressures. The thermal storage system consists of a Ruths steam accumulator, which has a storage capacity of 40,000 lb. and is 11 ft. 3 in. in diameter by 58 ft. long and was supplied by Ruths Area Accumulators, Ltd., who are represented in South Africa by Fraser & Chalmers, Ltd.

The output has increased to such an extent that a 2,000-kW Belliss & Morcom-English Electric set has lately replaced one of the original 1,000-kW sets, and figures relating to the past year's working show that a total of approximately 13¼ million kWh was produced, of which 53.4 per cent. was returned as a surplus to the municipal mains. The capital cost of turbines, transformers and switchgear for the original plant was £13,720, upon which 10 per cent. capital charges were debited to running expenses, and from a financial point of view the scheme has been of marked benefit to both parties. These charges, together with operation and maintenance costs, enable current to be supplied at 0.1061d. per kWh to the municipality, and 0.076d. to the refinery, according to the working costs of the year which has just closed. The actual costs vary with the length of running period of the refinery, which depends upon the position of the sugar market, but normally it is from eight to nine months in the year.



Modern sub-station on Esplanade

It is on the distribution side of the Durban undertaking that progress has been most marked, due mainly to the development of the domestic applications of electricity, which campaign was started as far back as 1914 by the introduction of a low domestic tariff with a running charge of ⅝d. per kWh.

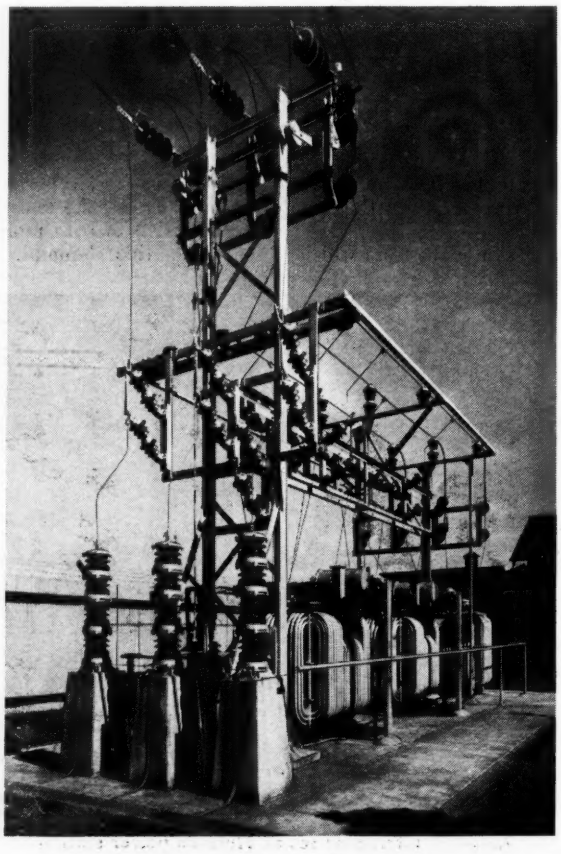
Distribution in the early days was by 2,750-V cables supplying single-phase transformers feeding into the low-voltage network at 200 V, while power demands for industrial purposes were met by a DC 550/500-V supply, which was also used for operaing the city's tramway system.

Prior to 1910 the distribution was confined to the Borough, but an Act empowering the Corporation to supply up to a radius of 16 miles beyond the boundary was obtained, and extensions soon followed to all the adjoining suburbs, a number of which were incorporated in the Borough in 1932, by which the area was extended from 12 to 67 square miles, with an increase in population from 125,000 to 215,661, and in 1935 the Borough was raised to the status of a city.

As previously mentioned, most of the energy used is now supplied in bulk by the Electricity Supply Commission, the tariff rate being £2 2s. 6d. per kW of actual demand, plus 0.175d. per kWh, and subject to an adjustment on the price of coal; the average cost for the past year's working was 0.315d. per kWh.

Until recently all current was supplied at 6,600 V, but the Commission has now installed 33,000-V generating plant, and the more heavily loaded distant distribution centres are, or are being, supplied at this higher pressure, at which centres it is transformed to 6,600 V for further distribution. The Municipality has erected a switch station adjoining the Commission's power station, equipped with Reyrolle metal-clad switchgear (with Merz-Price protection) having rupturing capacities of from 500 to 150 MVA, with reactors on the various 6,600-V cables radiating to the several sub-stations and distribution centres, of which the chief distribution centre is the late Alice Street generating station.

The original transmission had grown to such large proportions by the time that the Municipality decided to change over to three-phase generation, that single-phase distribution was continued by making use of 6,600/2,750-V Scott-connected phase transformers and balancing the load between the two phases by suitable grouping of the various concentric cables. In the newer suburban districts a similar system was adopted at first, but in recent years, with the increase in load, it was decided to re-arrange the system and transform direct from 6,600 V to the standard low voltage through single-phase transformers tapped off the various phases in turn, which re-arrangement is still being proceeded with and in practice has given quite a good balance between the three phases.



33,000-V outdoor gear at Clairwood sub-station

Power is transmitted at 33,000 V by overhead lines along the Natal south coast, with sub-transmission at 2,750 V for the supply to the various coastal resorts within the municipal radius of supply, and at its termination the Electricity Supply Commission, under an arrangement with the Municipality, has extended the line for consumers in various townships and municipalities further along the coast, as far as Port Shepstone, some 97 miles from Durban.

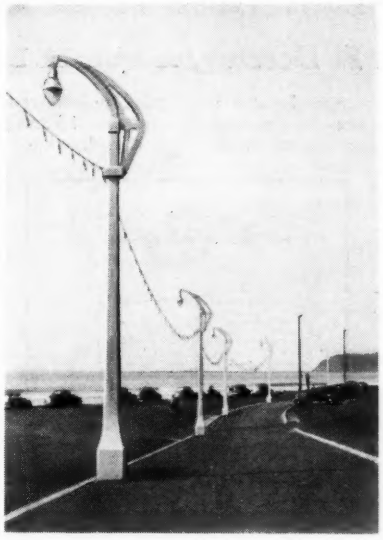
In the north coast direction, the transmission is at 6,600 V terminating just beyond Verulam, a distance of about 18 miles from Durban, along which route various townships are supplied in addition to brickyards and an important sugar mill, and there is a possibility that the Commission may extend beyond the municipal supply area, as it has done along the south coast, there being a number of sugar mills all along the north coast.

Energy is supplied in the other direction (inland) and transmitted for the nearby portion of the route at 6,600 V (the outcome of the gradual extension to

closely adjoining communities) but on demands for further extensions to the more scattered communities being made, it was decided to step-up at Northdene, some 11 miles out, from 6,600 to 11,000 V for transmission beyond, the low-voltage supply now terminating at Botha's Hill, the limit of the municipal supply area.

The industrial load was originally supplied at DC from separate engine generators at Alice Street, chiefly for the tramway supply, which plant was later replaced by convertors operating off the three-phase generators, but on the industrial demand showing signs of rapid development some years ago, it was decided to gradually eliminate the DC in favour of three-phase, either at 6,600 V or 550 V, depending on the load, and at the present time very little DC industrial load remains.

The convertor plant at Alice Street for the DC supply is manually controlled (as, in any case, a staff is retained at this large distribution centre) and consists of two 1,000-kW and one 500-kW Westinghouse convertors. Other converting plant also became necessary with the tramway growth, and in 1924 automatic substations were put down in three important districts of the town, in each of which are installed one 500-kW Metropolitan-Vickers convertor and equipment, while near the centre of the town a semi-automatic substation was established, the converting equipment consisting of one 500-kW M.V. auto-convertor and one 500-kW Westinghouse convertor manually operated, this latter set being used chiefly for the heavier day-load demand only, after which it is shut down and the sub-station left fully automatic until the following morning.



Street lamps on Beach Parade

At the present time the municipal transport system is undergoing a drastic change, following the trend elsewhere, in substituting trolley-buses for trams, as well as the introduction of oil and petrol buses on the newer routes, and it is anticipated that the end of 1940 will see all the trams off the streets.

The returns for the last municipal year show that there are a total of 586 transformer substations, kiosks, pits, &c., and 545 pole transformers for the distribution with an installed capacity of 213,060 kW, including two transformers of 10,000 kW each (Hackbridge) transforming down from 33,000 to 6,600 V for sub-transmission in the heavily loaded town area. Of cables there is a total of 826 miles, of which 241 miles are e.h.v. There is a total of 538 miles of overhead lines, of which 70 miles are e.h.v. The low-voltage distribution in the town proper is by underground cables, while in the residential and suburban districts the distribution is entirely by overhead lines.

The total number of consumers on the system now amounts to 37,080, of which 3,298 are motive-power consumers, the total revenue for the year amounting to approximately £700,000 from a sale of close on 200 million kWh.

As previously mentioned, the great development of the Durban undertaking has been chiefly due to the demand made on the domestic side for heating and cooking, which is now about 55 per cent. of the total load, and the graph on page 573 shows very clearly the growth of the various classes of demand during the past fourteen years, as well as the growth of the major types of domestic apparatus, which now include 17,685 cookers, 9,531 water-heaters, and 13,918 refrigerators, which growth of apparatus is also shown.

A popular tariff is largely responsible for the growth which was followed up in 1925 with a sound hire-purchase scheme for apparatus, as well as the usual propaganda. In connection with the hire-purchase scheme, it is interesting to note that since this was given effect to a sum of no less than £350,000 has been advanced by the Municipality. The ordinary domestic tariff within the city is founded on the "Norwich" system, with a minimum unit charge, based on the house valuation, of 4½d. per kWh, and all in excess thereof at ½d. per kWh, all less 10 per cent. for payment within thirty days. The ordinary industrial charge within the city is on a sliding scale of from 1d. to ½d. per kWh, also less 10 per cent., with special arrangements for large consumers at more favourable rates.

Before concluding this article a reference to street lighting may also be of interest, for, in common with other towns, fast-moving traffic has brought a need for greatly improved street lighting. Some 15 miles of the more important roads have been modernised by the substitution of both sodium and mercury-vapour lamps, and further extensions of this type of street lighting are in hand. In the less important streets fittings generally are being replaced by more efficient types with lamps of a higher wattage, there being at present approximately 12,400 lamps with a total of just over 1¼ million watts. Control of the street lighting is largely by means of hand-wound Venner time switches, which in turn operate relays to other circuits beyond, and experiments are now being made with selenium bridge controlled automatic switches.

Offices of the Electricity Department

The name of the late Mr. John Roberts (Durban's pioneer electrical engineer) will always be associated with the Durban undertaking. After thirty-six years' service Mr. Roberts retired in 1932 on reaching the age limit, and was succeeded by Mr. J. H. Gyles, who in August last also retired under the age limit, the appointment of City Electrical Engineer then passing on to Mr. C. Kinsman, A.M.I.E.E., who had held the post of assistant for the previous six years.

Mining Transformers

THE revision of B.S.S. 355, which was first issued in 1929, is announced. It defines the requirements for transformers of various sizes and types intended for use both above and below ground in mines as well as for bell signalling transformers. Copies are obtainable from the British Standards Institution, 28, Victoria Street, London, S.W.1, price 2s. 2d. post free.

COPPER CONDUCTOR DEFECTS

Origin in Various Process Stages

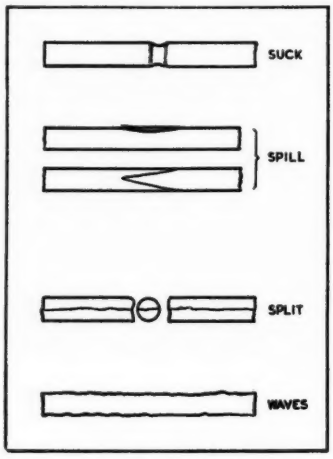
By J. E. Deering, A.Amer.I.E.E., F.I.P.

WHEN hard-drawing was instituted, copper became a practicable substitute for galvanised iron for overhead telegraph and telephone lines. This process raised the tensile strength of copper from 6.5 tons to 29 tons per sq. in.—almost equal to that of wrought iron or mild steel, while its resistance is only about one-sixth, being some 3 per cent. higher than that of standard annealed copper.

Generally, the more severe the cold working the smaller the crystal size and hence the higher the tensile strength (especially of a completely annealed wire) and the lower the temperature at which it begins to lose its work-hardness; also, the greater the rate of loss at any temperature, the higher the tensile strength becomes.

Most contracts for the supply of copper wire cite B.S. Specification No. 174-184, Paragraph 8 of which states that "the wire shall be approximately circular in section, smooth, uniform in quality, pliable, free from scale, inequalities, spills, splits and other defects."

Representatives of purchasing firms engaged upon the inspection of copper wire may detect physical defects and yet often be unable to discover their origin. Consideration of the different stages of manufacture will greatly facilitate the tracing of the causes of shortcomings.

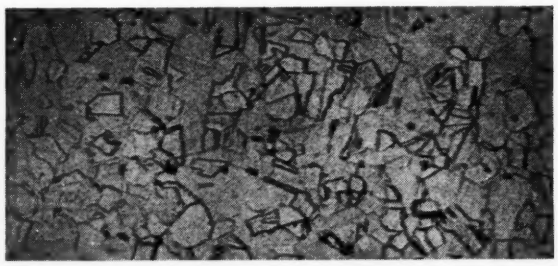


Types of defect

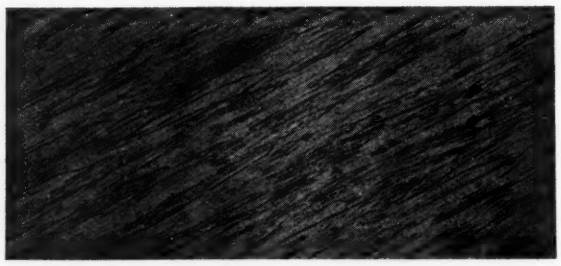
During its passage through a succession of rolls, after it has been ejected at white heat from the furnace, a copper billet, which initially measures 6 ft. by 4 in. by 3½ in. and weighs 250 lb., increases in length as its cross section diminishes. It emerges from the rolls at a greater linear speed than that at which it entered, since it not only takes up the speed of the rolls but is also squeezed forward by an amount corresponding to the reduction in cross-sectional area, reaching some 3,000 ft. per min. in the final pass.

Rapid operation is needed to prevent too great a difference in the temperature of the metal from one end to the other, which can cause as much as 1½ per cent. variation in tensile strength. To ensure a reasonable temper throughout, the rod, before being drawn into wire, is rough-annealed by heating at 1,200 deg. F. and quenching with water. It is then pickled in dilute sulphuric acid to remove mill scale.

During rolling, the shape of the cross-sections is varied from pass to pass, since if the section were circular throughout, fins would be produced; these would be bent over in the next pass to form "cold shuts," which might be below the surface for a distance and liable to remain throughout the complete process. A combination of shapes —squares, ovals and rounds —is therefore used and this kneads the copper, rendering it homogeneous and ductile.



Microscopic photograph of a section of high-conductivity copper ¼in. in diameter taken after rough annealing stage



Section of the same rod after it had been made into hard-drawn wire: weight 70 lb. per mile. Note uniformity of crystal formation

The next stage is the breaking down of the rod by pulling it through a die plate with twelve to eighteen holes. The dies are usually of steel, but sometimes cast-iron is used for copper. Diamond dies are employed for drawing long lengths of fine wire. Each hole has two zones—a short tapered one and a bell mouth leading up to the approach. The walls of the latter must be quite clear of the entering wire, which might otherwise cause the metal of the die to be drawn forward and piled up in the throat. This trouble can also occur if the wire is not well lubricated.

Wire-drawing blocks for heavy-gauge wire consist essentially of the die and its holder, the drum-like block round which the wire is coiled and a mechanism for pulling the end of the wire until sufficient length has been drawn through the die for attaching to the block. The face of the block is tapered upwards with a step near the bottom. This eases off the wire upwards as it is coiled on the drum and also enables enough turns to be wound on the block to provide the friction necessary for pulling the wire through the die. Pegs in the top of the block form a continuation and so increase its carrying capacity.

In continuous drawing (a process introduced sixty years ago, in which the wire is drawn through more than one set of rolls in series at the same time), the same trouble through extension of length is encountered as in the rolling process. The increase in length in wire drawing is not taken up by allowing the wire to loop as it would become unmanageable and so the wire passes through a succession of dies at an increasing speed.

Reverting to the defects mentioned in the B.S. Specification, a departure from circularity in section may occur during wire-drawing if the wire has slipped on the drum of the coiling block, resulting in a flat on the surface through rubbing. The same cause may account for lack of smoothness.

Non-uniform quality is traceable to impurities in the ore itself or to absorption of gases (which may give rise to blow-holes) when the ore is being smelted into billets. If a rod subject to cold working has not been rough annealed, its characteristics will remain fixed in subsequent annealing processes and the wire produced will lack uniformity in tensile strength and resistance. Unless the mill scale is removed by pickling it is liable to damage the dies and to result in a wire of bad surface. If during rolling a rod crowds the preceding pass and issues with fins, these may become laid into the rod and show up as "spills" on the surface. Scalping the rod eliminates this.

The origin of "splits" is in the smelting stage. If a fresh supply of metal is poured into a ladle which already contains a small amount of molten metal, the two will not mix or weld together. The seam or seal so formed will remain throughout the rod and wire, being rolled and covered in later stages so that it may appear on the surface at odd intervals.

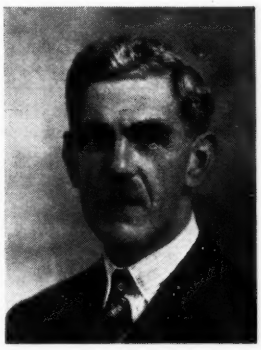
A defect known as "waves" can occur during the breaking down of the rod to a smaller diameter or during wire-drawing by the rod or wire crowding the die mouth and being cleared intermittently; "sucks" are produced in the same way. A somewhat rare fault, "piping," may occur when a billet is cast with a rough end which is the last to enter the rolls. The roughness being elongated along the length of the rod, the rough end may be slightly concave—producing a definite hollow in the back end of the rod for a considerable distance, which results in a wire having a very small hole through it.

EARTH-LEAKAGE TRIPS

A Review of B.S.S. 842

By E. A. Reynolds, M.A., M.I.E.E.

IN any electrical installation there is always some risk of contact being made between earth and some point at higher potential than earth. There is little likelihood of accidentally touching a live wire or terminal, but the danger is present if there is a fault or leakage from the live circuit to metal cases of apparatus, if such cases are insulated from earth. To safeguard against this danger means must be adopted to prevent the possibility of any exposed metalwork attaining a potential above earth high enough to cause dangerous shocks.



Mr. Reynolds is principal of the firm of Reynolds and Bradwell

The usually accepted method of achieving this in the past has been to connect the exposed metal concerned to earth by means of an earthing lead or some form of continuity conductor connected at one end to the exposed metal and at the other to an earth electrode. This arrangement would be perfectly safe if the resistance of the complete continuity circuit together with that of the earth electrode were low enough to cause sufficient current to flow in that circuit to blow a fuse or open a circuit-breaker before the metal to be protected reached a dangerous potential above earth.

In order to make certain that this will be effected there are two factors to be considered, namely, the value of the total resistance in the earth circuit, and the value of current that will blow the fuse or open the circuit-breaker. A high earth resistance may make it impossible to pass a sufficiently large fault current through the earth circuit to blow the fuse or open the circuit-breaker controlling the circuit, and accordingly the metal that is supposed to be protected remains at a potential high enough above earth to cause dangerous shocks to human beings, whose resistance is so high that the resistance of the earth is insignificant in comparison with it.

Even if the earth-continuity circuit and the earth electrode have a very low resistance, and, in fact, can be looked upon as a really good and satisfactory earth, a fault to the metal casing of the apparatus may not allow an earth-leakage current to pass that is large enough to open the circuit by means of the fuse or circuit-breaker controlling that circuit. For instance, if the rating of either of these were 200 A the circuit would not be broken on a dead earth fault across a total earth resistance of 1 ohm. Therefore other means must be adopted to provide protection under these circumstances, and earth-leakage circuit-breakers have been developed for this purpose, and as the result of investigation and research, British Standard Specification No. 842 has been evolved.

Limit of Potential Rise

The object of the earth-leakage circuit-breaker is to cut off the supply to an installation or piece of apparatus on which a fault has occurred before any exposed metal can reach a potential above earth sufficient to cause any serious shock to human beings, and in the Specification a limit of 40 V has been given to the rise of potential before the circuit is broken. Although it is mentioned in the foreword to the Specification that it would have been desirable from the point of view of safety to limit the rise of potential to 30 V, it was considered even more desirable to ensure that the apparatus was so constructed as to be thoroughly reliable over a long period without requiring skilled attention. A compromise has, therefore, been arrived at permitting the tripping voltage to reach 40 V when the earth-electrode resistance is very high but remaining below 30 V under more normal conditions, as specified in Clause 12, which also calls for a minimum tripping current of 15 milliamps.

In accordance with the Specification, the earth-leakage circuit-breaker is in the form of an ordinary circuit-breaker which is held in mechanically and released by mechanism actuated by a coil in the earth circuit when the voltage across the coil reaches a certain defined value. The impedance of this tripping coil only allows a small current to pass to earth, so that even if the resistance of the earth electrode is comparatively high this does not result in a high potential being set up at the electrode itself, the only appreciable rise in potential being that across the trip coil, and possibly at the point of leakage.

The continuity conductor, the coil of the earth-leakage circuit-breaker, and the earth electrode may form the only earth circuit, but, in addition, another earth circuit which is solidly connected to another electrode may be installed in parallel with this. A direct earth connected in this way would, however, appear to defeat in many instances the objects of the earth-leakage circuit-breaker. If the solid earth connection is to serve any purpose of efficient protection, the leakage current under fault conditions must be sufficient to blow a fuse or open a circuit-breaker, and if the earth resistance is low enough to cause this before a serious rise of potential of exposed metal is attained, the earth-leakage circuit-breaker is not considered necessary.

If the fuse or main circuit-breaker does not open the circuit under conditions of a fault to earth the whole protection will depend on the earth-leakage circuit-breaker which will act when the potential across it rises sufficiently. If, however, there are two parallel paths to earth, one taking a heavy current and the other a low current, the heavy current will raise the local earth pressure round that electrode, and may affect the electrode of the earth-leakage circuit-breaker, thus raising the potential of the earth side of the leakage-trip coil, consequently raising that of the continuity conductor to a possibly dangerous level without the earth-leakage trip acting to deaden the circuit. In order to prevent such interaction the two electrodes should be over 20 ft. apart, and in many installations it would be almost impossible to attain this.

Protection by means of direct earthing on a circuit fused at 30 A is only possible when the total earth-fault path has a resistance of not more than 4 ohms, and if the total resistance of the path exceeds 23 ohms no protection at all is provided by a 5-A fuse.

Application Under I.E.E. Regulations

This is recognised in the eleventh edition of the I.E.E. Wiring Regulations, and is provided for in Regulation 1,006, which requires earth-leakage protection on all circuits with certain exceptions. The earth-leakage trip must disconnect the circuit when the potential across the consumer's earth resistance exceeds 40 V, and the definition of the consumer's earth resistance is the total resistance of the earth continuity conductor and earth electrode.

The exceptions are :—(1) When the maximum possible earth-leakage current from a circuit can be proved to be greater than the overload value at which the fuse or circuit-breaker is set to operate. (2) Where the current rating of the fuse or circuit-breaker controlling the circuit does not exceed 100 A, and the metal-work of the installation is earthed to an urban system of underground metallic water mains having metal-to-metal joints. (3) Installations in which there are no exposed metal parts, that is, such as are "all-insulated" by using c.t.s. cable and bakelite fittings. In such cases it must be remembered that appliances used on these installations have metal cases, and that, therefore, there are very few that are all-insulated.

This Regulation makes it obligatory to examine the value of the consumer's earth resistance except under the three exceptions given above, which, however, cover installations in almost every town in the country, where underground metal water mains are almost universal, so that it is chiefly in country districts that earth-leakage trips may be generally required.

As already shown, the direct earth in parallel with the leakage circuit-breaker is often detrimental to the satisfactory working of the leakage trip, and, therefore, care must be observed in seeing that there is no fortuitous earth of low resistance in parallel with the earth circuit of the leakage trip. In factories and other large installations the bases of machines or other apparatus automatically provide parallel paths to earth, and these cases must be considered individually.

In some instances where the earth resistance is comparatively small the direct earth circuit may have a sufficiently low resistance to blow a 5-A fuse but not a 30-A fuse, so that

under these conditions it would be quite in order to rely on the direct earth for a small circuit for domestic lighting and arrange for a separate earth circuit with an earth-leakage circuit-breaker for a single purpose, such as a cooker taking a heavy current, isolating the continuity circuits of the two systems from each other.

On any installation several earth-leakage trips may be installed to protect individual circuits or separate pieces of apparatus without cutting off the whole supply. The use of several of these trips requires careful consideration of the arrangement of the earth-leakage paths so as to prevent a local leak affecting other circuits besides that on which the leak has taken place.

The general continuity path of the conduits or other metallic protection of the circuits is connected to an earth-leakage trip in the ordinary way. The metal case of any individual piece of apparatus to be protected must be insulated from the general continuity circuit and a separate earthing lead taken from this metal through its own earth-leakage trip to the main earth electrode, or it might be connected to a separate earth electrode if more convenient.

If the piece of apparatus to be protected is connected by means of a three-pin plug to a socket outlet, the earthing pin of the socket outlet must be disconnected from the main earth continuity circuit, and the separate lead taken from that pin through its own circuit-breaker to the earth electrode. This separate earthing lead can be in the form of lightly insulated cable run with the circuit cables in the conduit.

If there is only one earth-leakage trip on an installation, it may be supplementary to the main switch of the supply, or can be incorporated in a circuit-breaker of suitable capacity which may replace this main switch. As there is a test key fitted in the earth-leakage trip for opening the circuit-breaker, this test key could be used as the normal means of cutting off the supply when required, and this would ensure that the test-key circuit and the earth-leakage trip are in satisfactory working condition.

In the foreword to the Specification it is pointed out that in some rural areas the earth resistance may even exceed 500 ohms. As the Specification deals only with earth resistances up to 500 ohms, when a higher resistance is encountered the best course would be to adopt some method of trying to reduce this resistance as set out in a schedule at the end of the Specification. If the earth resistance cannot be reduced to below 500 ohms special earth-leakage circuit-breakers must be obtained from the manufacturer which will operate at not more than 40-V rise with the specified resistance connected in series with them.

Reducing Earth Resistance

In the schedule referred to two methods of reducing the earth resistance are given, one by the introduction of a second earth electrode not less than 6 ft. away from the first and connected in parallel with it, and the second by the salting of the soil round the electrode; the amount of salt required is approximately 2 lb. per cu. ft. of earth. This treatment of the soil consists of mixing common salt with a large volume of soil round the electrode. If this electrode is in a particularly dry position the salted earth should be kept damp by means of watering at intervals in dry weather.

Exhaustive research is being undertaken on the corrosive effect of the salt on the electrode itself, and also on the deterioration of the salting effect on the reduction of the resistance after some years, but it is probable that the useful effect of the salt will last for a considerable length of time without serious deterioration of the electrode.

In the Specification, Clauses 13 and 14 call for insulated cases and insulated handles. This is necessary, for if these were of metal they would themselves have to be protected by a second earth-leakage trip, because direct earthing to these would be no more protection than it would be for the metalwork of the rest of the installation. Clauses 16 and 17 deal with the provision of a test key, and the method of testing through a resistor called for in Clause 11. This test key closes a circuit which allows current to pass from the supply through a resistance in series with the trip coil which will not exceed 150 per cent. of the minimum current that will trip the circuit-breaker with 500 ohms resistance in series with it to represent the maximum earth resistance for which these leakage-trips are designed.

Reliability of Leakage Trips

Some engineers doubt whether the earth-leakage trip will continue to afford protection after being installed for some years, and whether the wire with which the trip coil is wound might not be a rather fragile part of the earth circuit. Where these have been in use for several years experience does not support this view, and their reliability in use has proved quite satisfactory. These coils can be damaged by lightning, but such occurrences have been rare, and damage has also been caused through lightning to installations with a direct solid earth.

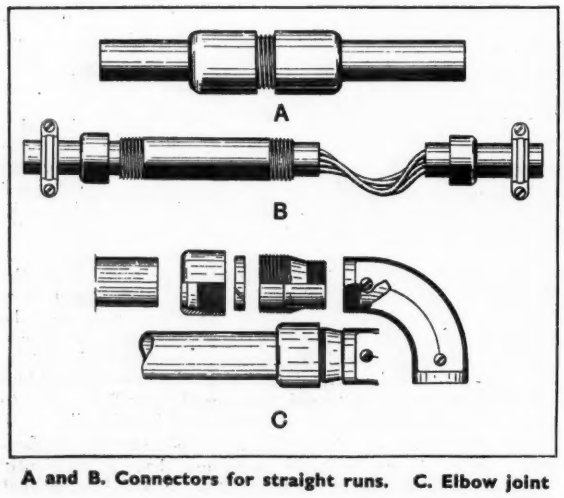
Another form of earth-leakage trip not covered by this Specification is used in some cases for the protection of large three-phase motors, and other balanced three-phase circuits. The principle involved is known as the "balanced-core system," in which a coil is energised if the three phases are out of balance, which condition will be caused if there is current passing through the earth to the earthed neutral of the three-phase system at the transformer. Such a method of protection can be designed to work on leakage currents that are reasonably small compared with the full-load rating of the circuit-breaker.

In the eleventh edition of the I.E.E. Regulations, No. 711 C. calls for an earth-leakage circuit-breaker to be fitted under certain conditions in the circuit to electrode water heaters. This is not covered by B.S.S. 842, the earth-leakage current in this case being limited to 10 per cent. of the current used by the apparatus.

In this article an attempt has been made to show that the problem of protection from shock is not simply solved by providing a good earth-continuity conductor and connecting this to an earth electrode of which the suitability is assumed, and that the ordinary idea of appropriate safeguards for protection from shock often leads to a fool's paradise in which no protection exists.

French Conduit Connectors

A FRENCH contemporary reports the growing use in France of what are known as "rational" connectors to enable plain steel tubing to be used as a substitute for the more customary form of screwed steel conduit in electrical wiring installations. The system, which has been introduced by the firm of M. J. Verger, of 141 ter, Rue Saussure, Paris, 17, comprises, for straight lengths of conduit, an externally screw-threaded sleeve and two capped nuts which are slipped over the ends of the lengths of conduit to be connected together. Part of the inside of the nuts is made slightly conical and after the sleeve has been centrally located on the joint, the nuts are tightened up, a secure connection being ensured by the use of a split spring washer.



A and B. Connectors for straight runs. C. Elbow joint

The threaded sleeve type of connector is made in two patterns, one for use where the conduit ends abut one against the other, and a longer sleeve which, after loosening the nuts, may be slid back to allow the wires to be inspected (see A and B in illustration). The connector for elbows, while embodying the same idea, is made on slightly different lines (see C). Its feature is the employment of a double-diameter screwed sleeve, one end of which is screwed in the elbow, while the larger end is brought up tight against the end of the straight conduit by the employment of a nut and split washer.

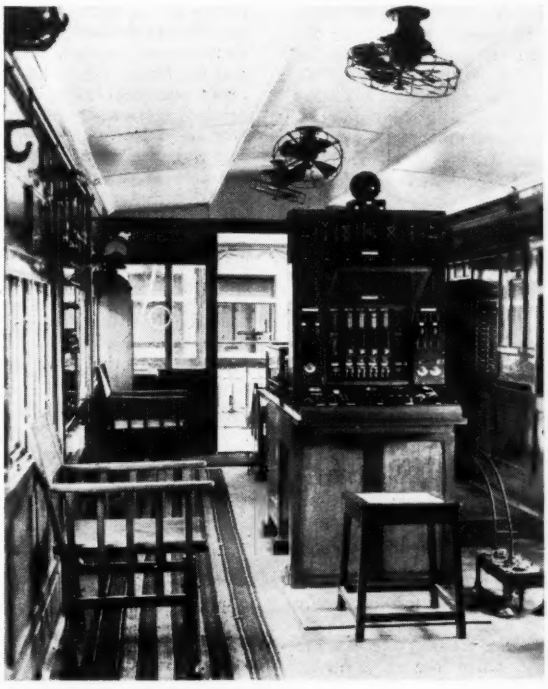
It is claimed for the new connectors that, as screw-threading does not have to be done when installing conduit, a saving of as much as 50 per cent. in labour costs can be effected, and screwing tackle does not have to be carried about; the enclosed wires can be easily inspected and readily be replaced, and additional wires can be inserted, without taking down the conduit. These connectors have been officially approved by the Compagnie Parisienne de Distribution d'Electricité.

RAILWAY TRACK MAINTENANCE

Method of Recording Defects

THE Great Indian Peninsula Railway has produced a track recording car, designed by the chief electrical engineer, Mr. H. J. Mulleneux, and built under his supervision in the railway workshops, which detects and records any flaw in the track that might be directly responsible for discomfort and indicates the spot by a whitewash mark on the track.

The car consists of a standard bogie coach, with an observation verandah that opens into the instrument room, at the end of which is a compressed-air plant and the whitewash mixing room. The other half of the car consists of accommodation for the staff. In the instrument room is found the Hallade recorder, the main instrument table, the lateral, vertical and curvature detectors and the power switchboard. The Hallade recorder has been tied in with the electrical gear in order to ensure that the vehicle will always operate under the same conditions of vehicle springing and for purposes of comparison. The air compressor is driven by a 1-HP motor and is automatically controlled to keep the pressure between 45 and 50 lb. per sq. in.

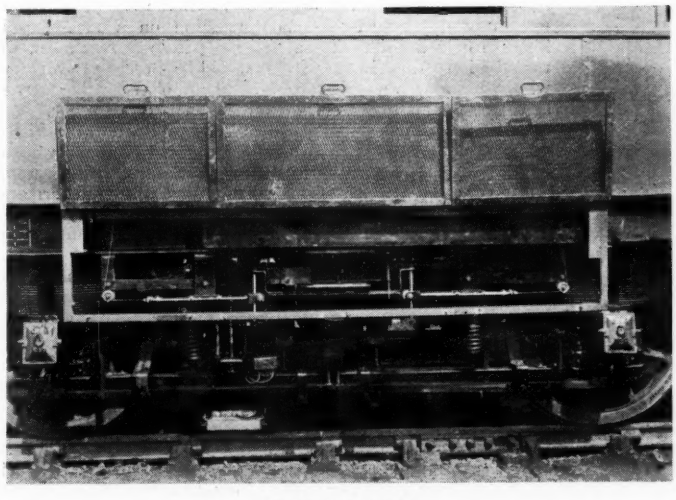


Interior of car

The whitewash tanks are below the floor level of the coach and are fed from a 50-gal. tank which is fitted with a hand mixer. The connecting pipes can be blown clear by compressed air. Each tank has a capacity of 110 shots between green light (full) and red light indicators, the latter functioning when a further 35 shots would empty the tank.

The disadvantage of a time element, due to the clockwork drive of the Hallade recorder, has been overcome by driving its chart from one of the axles. Both this chart and that of the electrical recorder use 8 in. of chart per mile, irrespective of the speed of the car.

The speed of the axle is converted by suitable means to three different speeds suitable for the speedometer and the electrical and the Hallade recorders, all of which must run in the direction in which the car is travelling.



Detecting bogie

Manual reversing during shunting is obviated by an automatic reversing box. A cork-inset plate clutch of the motor-cycle type sets the stationary parts spinning until synchronous speed is attained, when a dog-clutch provides a direct drive.

A clockwork mechanism energises a circuit at 4,000 V every 15 sec.; this burns a pinhole through both charts, thus recording the speed. By means of adjustable mirrors in the sides of the car, the observer can see a considerable distance ahead on both sides of the track. Test and emergency connections are facilitated by bringing all electrical circuits (of which there are 117) to a central panel under the instrument table.

The action of the low-rail joint detector depends on the movement of the axle box in relation to the bogie when traversing a low joint at above 10 to 12 miles per hr. Its sensitivity can be set within wide limits. At 60 MPH the wheel of the vehicle passes over three joints per sec., and if the joint is low the duration of the vertical movement is in the neighbourhood of 0.01 sec. At normal speeds the whitewash mark was found well within 10 ft. of the faulty joint, the total operation lasting 0.2 sec.

Lateral Swing

The speed component of all lateral movement, which originates in the bogie, following the track and diverging from the line of the coach, is the governing factor of the lateral swing detector. The lateral movement is converted first to a vertical movement and then by means of an archimedean screw to a rotary movement which is utilised to drive the armature of a small dynamo with rheostatically controlled field.

The curvature and track detector depends on the deviation between the centre line of the coach and that of the bogie. After correction for all elements of mechanical play, this deviation is electrically summarised before transmission to an indicator, which shows the radius of the curve. This instrument is in series and records the theoretically correct super-elevation for the curve traversed. It has been found to be accurate within 2 per cent.

A transverse-level detector (which indicates super-elevation as well), having a steel beam pivoted at its centre from which two pendulums are suspended, deals with centrifugal force while travelling round curves. It remains level under all conditions. The effect of lateral swings, as distinct from centrifugal force, is damped out by a system of small eddy-current brakes and oil dashpots. A light pointer carrying a pen records the actual difference in transverse levels of the two rails.

Gauge Detector

The gauge detector consists of electro-magnets designed to suit the average section of rails and is suspended longitudinally 1 in. above the rail. The magnets are pivoted at a certain point in relation to their centre of gravity and the head of the rail bneath completes the magnetic circuit. They follow all lateral movement of the rail. As long as the rails are correct in gauge, the balance of an electrical circuit remains undisturbed but any variation in gauge will cause the magnets to swing out of unison. The instrument is accurate within ¼ in.

Any depression in the rail due to faulty packing or a "high spot" rail will cause a relative vertical movement between car and bogie. In the detector a vertical rod resting on a small table fixed to the bogie slides in guides fixed to the body and in doing so moves two roller contacts. These contacts in turn bridge two contact

(Concluded at foot of next page.)

METER TESTING

Problems Arising with Heavy-current AC Types

By G. W. Stubbings, B.Sc., A.M.I.E.E.

IN the official specification for methods of meter testing issued by the Electricity Commissioners supplementary to the Electricity Supply (Meters) Act, 1936, it is stipulated that normally every meter intended for use with a transformer shall be tested with that transformer. In appropriate cases, however, the Commissioners may approve other methods, such as the separate testing of meters and transformers.

These alternative methods have drawbacks. The direct method requires a heavy-current three-phase circuit for the routine testing of polyphase supply meters, with sub-standard instruments to cover a wide range of currents. With the indirect method the technique of the actual meter testing and the equipment for it are simple. but the separate measurement of transformer errors requires special apparatus. Further, there is a possibility of arithmetical error in calculating the actual errors of the meter in varying conditions from the results of the two series of tests.

Another Method

There is a method of testing heavy current AC meters which has all the advantages of the ordinary indirect method without its drawbacks, but it is practically applicable only to meters with current transformers of special design. The accompanying diagram shows a simple single-phase test circuit comprising an ammeter A, a sub-standard wattmeter W and a current regulating resistance R, together with the meter M. Its peculiarity compared with one in which the meter is tested without its transformer, is the inclusion in the current circuit of an impedance Z, the resistance and reactance of which are equal respectively to the secondary resistance and leakage reactance of the meter current transformer, while the transformer secondary winding is connected in shunt to the meter and impedance combination. The primary of the current transformer is open-circuited.

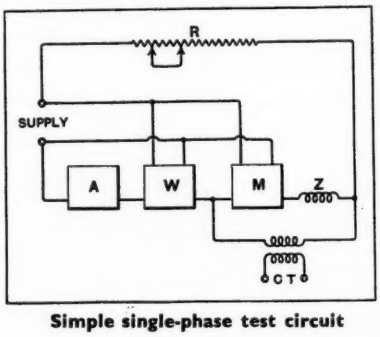
With this circuit the current transformer secondary diverts a small fraction of the main current of the testing supply from the meter current coil. This current corresponds exactly in magnitude and relative phase to the transformer exciting current, referred to the secondary, when the same meter current is supplied from the current transformer.

If the current transformer is free from turns compensation (*i.e.*, if its turns ratio is the same as its nominal ratio) it follows that the percentage difference in the magnitudes of the meter and the main currents in this circuit will be the same as the ratio error of the transformer when delivering the meter current, and that the phase difference of these two currents will correspond to the phase error of the transformer in this condition. Thus, provided two conditions are satisfied, first that the current transformer is not turns-compensated and, secondly, that the characteristics of the impedance Z correspond to those of the current transformer secondary, the meter can be accurately tested in a 5-A circuit, and allowance for current transformer errors is automatically made by the shunting effect of the secondary winding connected in parallel with the meter and the impedance Z. This method, therefore, subject to the conditions being satisfied, gives the equivalent of a heavy current test.

The two conditions can rarely be satisfied with the older types of metering current transformers with Stalloy cores. With these transformers the errors are considerable, and the actual ratio errors are reduced by turns compensation. When the turns ratio of the transformer does not correspond to the actual nominal ratio the current shunted from the meter in the circuit illustrated is greater than that corresponding to the corrected ratio of error of the current transformer, and the indirect method of testing corresponding to this circuit is therefore not correct.

If the turns ratio of the transformer is known, a correct test result can be obtained by using this ratio instead of the nominal ratio when calculating the meter power. This, however, is not often feasible because, although the amount of turns compensation can often be estimated with moderate certainty, it is rarely given explicitly by manufacturers.

A much more serious difficulty in the application of the indirect method of meter testing under consideration to meters with Stalloy core current transformers is that it is hard to determine the secondary leakage reactance of these transformers when, as is often the case, the secondary winding is in two separate sections. Even if the value of this reactance could be determined or estimated with fair accuracy it would be difficult to adjust the characteristics of the inductive impedance Z so that both its resistance and reactance had the correct values. For these reasons the indirect method which has been described was only of theoretical interest so long as the only metering current transformers available were those with Stalloy cores.



Simple single-phase test circuit

The development of commercial metering current transformers with cores of a high-permeability magnetic alloy would, however, make it much easier to satisfy the conditions requisite for the accuracy of the indirect method of testing meters.

In the first place the errors of such current transformers are so small that turns compensation is quite unnecessary, and the turns ratio is the same as the nominal ratio. The meter power method of testing of the diagram would therefore be calculated in the usual way. In the second place, a uniformly distributed secondary winding on a ring-shaped high-permeability core has a negligible leakage reactance, so that the impedance in this circuit would be merely an ordinary wire non-inductive resistance having an ohmic value corresponding to the secondary resistance of the transformer.

Thirdly, as the errors of current transformers with high-permeability cores are very small, any slight inaccuracy in a method of testing with indirect compensation for these errors will be of little moment. Thus meters used with transformers of this kind can be tested in a 5-A circuit with the same accuracy as would be given by a heavy-current circuit. The only complication, as compared with the ordinary 5-A test, is the compensating resistance corresponding to Z, and the connection of the secondary circuit of the current transformer.

Transformer Errors

It is sometimes thought that if a supply meter is used with transformers with high-permeability cores the transformer errors will be so small in relation to the allowable limits of meter error that it will be unnecessary to test the meter with its transformers. This view is hardly a sound one. Although the errors of high-grade current transformers may be almost negligible from full to one-fifth of rated current, this will not as a rule, apply for currents from one-fifth down to one-twentieth of full load, within which range the stipulated limits of error of the meter must not be exceeded. Some method of testing in which allowance is made for these small but appreciable errors will therefore almost certainly be necessary, even when using transformers with high permeability cores.

Railway Track Maintenance (*Concluded from preceding page*)

strips, one of which is adjustable, so that when the roller contact leaves it the electrical circuit is broken and the relay gear falls into action. The minimum limits of this vertical swing can be set within 0 and 5 in.

The relays operating on the lateral and vertical detectors are held open but if the circuit is broken, the relay falls and closes the next stage circuit thus reducing the time lag by 35 per cent. The operation can be set to function within 0.2 sec. and discharge a pint of whitewash. This corresponds to a speed of 70 miles per hr.

Two records on gauge for the same five miles of track were taken at intervals of a week at speeds varying from 27 to 55 miles per hr. Although the variation of gauge did not exceed ¼ in. at any point, every indication was almost identical in the two charts.

The car is equipped with a 100-A 24-V dynamo driven from one of the axles, and two 320-Ah 24-V batteries and can operate as an ordinary coach when not carrying out tests.

OPERATION OF THE GRID

Mr. Johnstone Wright's Presidential Address

A SUMMARISED account of some of the experience gained from the functioning of the national interlinking grid as an established entity is given by Mr. Johnstone Wright (chief engineer of the Central Electricity Board) in his presidential address to the Institution of Electrical Engineers, which has been issued without being read at a meeting.

The only part of the country not covered by the scheme in full operation is North Scotland, for which area nothing further is contemplated at present.

The financial results to date are even better than those envisaged and on the ground of conservation of capital resources alone there has already been a substantial net contribution to economy. Incidentally, the constructional work and standardisation of frequency, which were carried out in a period of acute depression, resulted in a substantial increase above the normal capital expenditure of the industry at a time when such expenditure was most needed. Also, the design and constructional experience gained has put manufacturers in a position of equality with their competitors abroad.

The actual expenditure on frequency standardisation up to the end of 1938, when the work was virtually completed, was £17.3 millions, some part of which is recoverable as antedated expenditure subsequently needed for normal development. Government unemployment assistance grants have relieved the industry of annual charges aggregating £1.74 millions up to the end of 1938. The maximum burden actually placed on the supply industry in any year has been 0.88 per cent. of the revenue from the sale of electricity. The peak incidence has now been passed, but had this work been further delayed until the present time the cost would have been well over £30 millions. The amount of plant changed over included 160 turbo-generators of 930,045 kW, 706 convertors of 382,569 kW, 102,189 motors of 1,901,315 kW, and 392,915 consumers were involved in the change-over.

Lafayette

Mr. Johnstone Wright
President I.E.E.

Turning to the operation and maintenance of grid equipment, erected at a cost to date of over £30 millions, Mr. Wright claims that in relation to the size of the system the number of faults has been small. Not one 132-kV tower has been seriously damaged by natural agencies. In certain small areas corrosion has necessitated the application of protective coatings to the steel cored aluminium conductors, but on over 99 per cent. of the total length of lines aluminium deterioration is less than one per cent. per annum for the outer layer and still less for the inner. Only a few insignificant instances of deterioration of the galvanised-steel core have as yet been encountered.

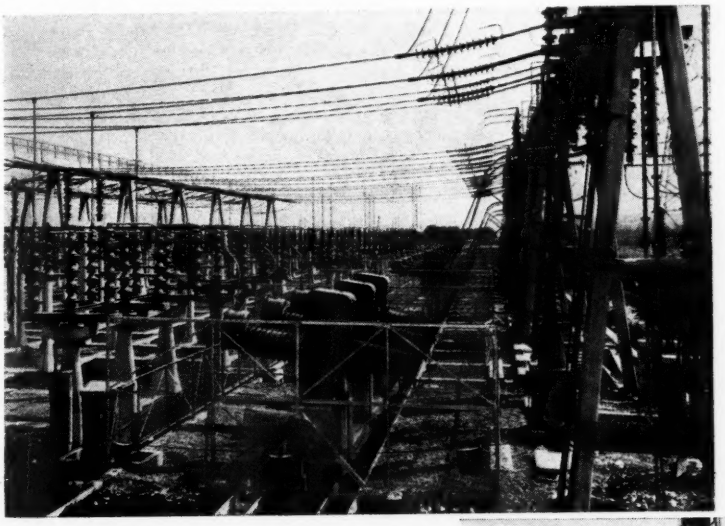
Standard line insulators have been satisfactory on about 90 per cent. of the system. Special types of insulators have kept within manageable limits flash-overs caused by industrial dirt, salt, snow, ice, fog and frost. The last two mentioned are far more troublesome than the others, but lightning remains the most frequent cause of faults. In the last six years it has caused an annual average per 1,000 miles in service of about nine flash-overs on 132-kV lines and 34 on lower-voltage lines.

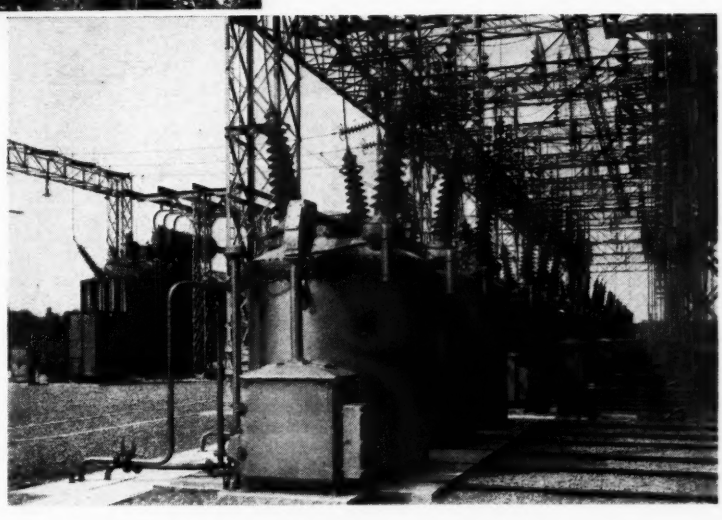
Bushing insulators for transformers and switchgear have been remarkably free from trouble; the condenser type has shown three general types of weakness, namely, ingress of moisture, surface tracking and puncturing due to internal voids. The technique of testing this and other classes of insulators is still somewhat obscure, and Mr. Wright commends the subject to educational institutions as worthy of close attention.

Manufacturers are urged to persevere in their efforts to provide more silent transformers and cooling gear as it is becoming exceptional to find sites remote from dwelling houses. The C.E.B. equipment is believed to constitute the largest installation of switchgear operated by one management. The relations between the short-circuit conditions imposed by test plant and those encountered in supply service are not yet fully understood. The trend of circuit-breaker development towards the small oil-content stage is illustrated by the accompanying comparative photographs. The oilless circuit-breaker has advantages which will probably make it preferable for many applications.

Pilot-wire protection was not practicable throughout the grid system, since the limited number of pilots used have cost £3.5 millions. For the year 1938, correct operation of the protective gear as a whole reached 88 per cent., and certain of the areas attained 96 per cent., which is probably about the maximum attainable without expenditure disproportionate to the gain to be derived. Of great promise in overhead-line protection is the carrier current system by which power lines themselves are used as pilots for conveying high-frequency tripping or locking impulses. The complicated high-frequency apparatus has not yet been completely adapted to power-engineering needs.

In a plea for the standardisation of wiring systems Mr. Wright observes that much of the time spent by young engineers in their





Bank of standard oil circuit-breakers, and right: High-speed low oil-content breakers

training is expended on obtaining familiarity with numerous unessential variants of what are fundamentally the same schemes. Surely it is to the common interest that schemes should be rationalised so that wiring systems, acceptable to all parties involved, could be utilised by technicians from their college stage onwards. This basic principle applies to all classes of electrical equipment, and he hopes some effort will be made to give it general application.

For operating the grid system the C.E.B. rents from the G.P.O. 5,000 radial miles of communication channels. For lengthy periods during last year the whole grid was run in parallel, without incident, with a maximum load on the interconnected stations of the order of 6,730,000 kW. Even when inter-operating on a large scale there is no sign of instability provided the majority of the grid lines are kept in service.

Apart from savings in spare plant and in capital charges grid control makes possible the allocation of load in accordance with cost efficiency. For instance, in 1938, only 30 of the 171 generating stations under the direction of the C.E.B. were kept running throughout the year; 14 of the most economical stations supplied 50 per cent. of the total kWh generated for the C.E.B. and 52 stations ran for less than 2,400 hours. But the resulting increase in thermal efficiency has been largely offset by the rise in price of fuel since 1935. The rise in the price per ton at stations operating under C.E.B. directions has been more rapid than the increase in price to other home users of coal.

The factors which make up station performance need closer examination. Thermal efficiency is customarily expressed as one overall figure, but Mr. Wright suggests that it might be well to separate the three factors, namely, ideal, maximum plant and operating efficiencies.

Station Sites

In outlining the procedure involved in extending generating capacity Mr. Wright observes that riverside stations have the lowest capital costs, followed by cooling-tower stations, while stations on coastal estuaries have the highest capital costs owing to the expensive civil engineering work required. With modern high-efficiency cooling towers, re-cooled temperatures of 75 deg., 70 deg., and even 65 deg. F. are possible in the average hygrometric conditions obtaining in this country of 51 deg. F. wet-bulb temperature, when working on cooling ranges of 14 deg. down to 10 deg. F., and in these circumstances a cooling-tower station may be designed for an average annual thermal efficiency very little lower than that at a riverside site, enabling future plant to be placed nearer load centres, with substantial savings in transmission.

He urges upon those engineers responsible for the design and construction of new stations the necessity for closer investigation of the factors which finally determine capital and other fixed costs of operation. Such costs appear to vary over a large range, which cannot altogether be explained by variations in site conditions. A comparison of the records of running economy and reliability does not by any means justify the apparently high relative costs per kW of certain stations.

There is a wide gap between the average availability of turbo-alternators and boilers, and every effort should be made to ensure better boiler availability and thus avoid capital locked up in the boiler house lying idle for long periods of the year. Where high gas velocities had been employed in the economiser and air-heater sections of the boiler, rapid fouling occurred with certain brands of coal, and in certain cases the pressure-drop increased by 10 per cent. in under 400 hours' service.

In the more recent types of boilers, the adoption of larger combustion chambers, coupled with an increase in the amount of heat absorption by radiation in the combustion chamber and a reduction in the amount absorbed in the convection passes of the boiler, has led to some improvement in availability, and recent experience gained on a high-head type of stoker-fired boiler shows that after 2,500 hours' continuous service, during which 14 different brands of coal were used, it was still possible to obtain 25 per cent. overload, although the gas passes had been cleaned by soot blowers only.

Re-Modelling Older Stations

The national scheme as it now stands differs in one important particular from the original proposals. Whereas the Weir Committee contemplated that national needs could be met by a total of 58 selected stations, the Board found that certain stations not suitable for selection had some residue of useful economic life in association with the grid, and in 1938 the Board had under direction the operation of no fewer than 171 stations, including 137 selected stations. In present circumstances the retention of these additional generating stations constitutes an asset of material value from a national point of view, since, apart from defence considerations, with spreading urbanisation suitable generating sites are increasingly difficult to secure.

Not all the sites still retained are suitable for redevelopment, but most of the older stations will still continue to give service under the grid scheme. They have fulfilled useful peak-load functions up to now, and as the existing equipment is amortised many are being—and will be—reconstructed to give a good account of themselves in years to come. With this end in view, a careful investigation of the site conditions at each station is in progress, and in many cases it has already been found possible, by the purchase of additional land, to envisage modelling the station up to three or four times the original designed capacity. Even so, the rate of growth of load is so rapid that already the Board has made definite arrangements for the provision of 12 new selected stations.

The total national installed generating capacity in 1927 was approximately 5.2 million kW. Since that date there has been installed, ordered, or approved for installation up to the year 1942, under arrangements made by the Board, a total of some 5.7 million kW, involving a capital expenditure of approximately £81½ millions, which is almost three times the capital expenditure on the original grid.

Colliery Electricians and the War

LAST Saturday at Mansfield, members of the Midland Branch of the Association of Mining Electrical Engineers listened to the inaugural address of their branch president, Mr. A. G. Connell, who is the chief electrical engineer to the Staveley group of collieries, chemical works and foundries.

Now that abundant supplies of coal were more than ever the life-blood of Britain's industries, he said, there was no need to emphasise the vital part to be played by colliery electrical staffs in ensuring that the pits were served with a full knowledge of modern electrical requirements and well-maintained equipment. But it was not so easy to obtain money to spend on the most up-to-date plant, and the situation must be reviewed with the knowledge that manufacturers were struggling with heavy commitments to the fighting services. Yet colliery requirements must be met and met promptly. How could plant-makers be helped to give good service and quick deliveries?

In the past colliery engineers had all wanted something a little out of the ordinary or some feature which required additional drawings and a return to the testing routine at Buxton. In peacetime that was all to the good, and most improvements had come about in this way; but with the nation at war they must put their heads together and standardise so far as they reasonably could.

A scheme was coming into being whereby the Mines Department would make a point of giving the collieries all possible help to obtain supplies, and Mr. Connell earnestly asked for this matter to be given deep thought. Practical knowledge and experience as well as good will would be necessary to make such a scheme work smoothly and effectively. They needed to go carefully through electrical lay-outs and equipment to find how much non-standard gear could be done without for the future. They might possibly be asked to submit details of equipment to District Supply Officers, and it would be most useful to have lists ready covering plant in use, spare plant, and plant for normal requirements for the future. These lists could be gathered and centralised and the information in them collated so that a comprehensive picture could be drawn not only of future needs alongside manufacturers' capacity, but a possible emergency pool could then be arranged of existing spares.

With the best will in the world Government schemes were at times irksome, but with colliery backing and considered advice such a scheme could be of great national value. Colliery electrical engineers carried the responsibility, so why not make this their particular scheme and give those who were carrying the burden on behalf of the Government the advantage of their loyal and intelligent co-operation? They had all noted the trend of modern events and the recognition already obtained by their Association. The future held an even brighter outlook, and the president asked them all to pull together to see that the value of the Association was fully appreciated. They could do this collectively and also individually by showing the management and owners what electricity could do for the coal industry.

The Coal Mining Regulations relating to electricity, with the revision of which Mr. Connell had been asked to help the Mines Department, were being modified with a view to making the difficult tasks of the colliery electrician smoother and a little more straightforward.

MODERN SUPPLY PRACTICE

Some Constructive Criticisms

DOMESTIC load building, the functions of a supply undertaking's testing department and relations between users and manufacturers were topics discussed by Mr. O. Howarth (Lancashire Electric Power Co.) in his inaugural address as chairman of the North-Western Centre of the Institution of Electrical Engineers at Manchester.

Conservatism was one of the greatest obstacles to electrical progress, declared Mr. Howarth, who said he had found many electrical engineers to be twenty years behind the times in their knowledge of domestic electrical apparatus and the cost of its use. There was evidence that enlightenment was spreading. It was noteworthy that papers on the utilisation of electricity in domestic premises drew audiences which were among the largest.

Mr. O. Howarth

Undertakings were already giving supplies to 64 per cent. of existing premises, so that the limit to the number of consumers was about 55 per cent. above the present number with a stationary population. In the circumstances, one must look to an increased use of electricity among existing consumers for development of supply. Tariffs were important, but the cost of appliances was also a serious factor. The annual cost of an electric cooker was about the same as the annual cost of the electricity it consumed. The cost of lamp renewals was equal to about ¼d. per kWh consumed. Radiators were among the cheapest appliances in first cost and upkeep, and the purchaser had the choice of a wide range from the highly ornamental to the really cheap but effective ones.

Adequate Wiring Discouraged

The wiring regulations, which called for a separate sub-circuit for each pair of 15-A plugs, discouraged the provision of reasonable facilities by making them unnecessarily costly. There was no reason why a 15- or 20-A sub-circuit should not be used to supply three or four 15-A plugs, all situated in one room of normal size in a house. It was a great convenience to be able to plug a 2- or 3-kW radiator in different positions, and it was obvious that the total load in a living room or bedroom would not exceed 3 or 4 kW.

With the type of flat-pin plugs so popular in the Manchester area, 5-A and 2-A fused plugs controlling 1-kW radiators, lamps, wireless sets, &c., could safely be plugged into the tops of the 15-A plugs, or direct into the 15-A sockets, and such an arrangement was inexpensive, safe and very convenient, although the Wiring Rules precluded their use. Mr. Howarth said he sincerely hoped that the I.E.E. Wiring Rules would not be changed from their present very voluntary status unless, and until, they became far less academic and much more realistic so far as domestic premises were concerned. If they should become compulsory in their present form they would undoubtedly be a serious obstacle to domestic development.

Much of the criticism of tariffs came from those who were ignorant of the distributing and selling technique of the supply industry. While it was true that load could not be built without suitable tariffs, it did not follow that because the tariff was suitable the load would grow automatically. If electricity for cooking were offered free to all those domestic consumers who purchased and installed a conventional de-luxe cooker suitable for four persons, it would be many years before 50 per cent. of the domestic consumers had electric cookers. If a similar offer were made in respect of 1-kW radiators, the response would be rapid and considerable. The reason for the difference in response was that radiators which would do their job quite well could be purchased for 10s. or even less.

Domestic load building demanded that the policy adopted in radiator design and manufacture should be adopted in the design and manufacture of cooking appliances. Was the breakfast cooker so called because it was so unsuitable for warming milk for supper and so utterly incapable of cooking chipped potatoes for high tea? Yet it could be designed to perform these two functions quite as well and almost as rapidly as the latest electric boiling plate, without in the least impairing its function as a griller.

Mr. Howarth said he doubted whether it was generally realised that the unsuitability of the conventional griller for boiling and frying was doing considerable harm to the supply industry by discouraging municipal councils from relying solely upon electricity in their houses. They installed a gas boiler and an outlet for a gas ring, whereas if they were able to offer a good and cheap griller-boiler which would be used for boiling and frying, many more electric wash-boilers would be installed. The sheathed tubular element gave far more satisfaction in use than the more conventional type, but in Mr. Howarth's view this was due to its effectiveness for boiling and frying. It was not very satisfactory as a griller and its initial and maintenance costs were beyond the reach of the low-income household.

There was scope for considerable modification in the design of electric ovens. At present they were only available as part of a complete cooking equipment, the cost of which was such as to take it quite out of the reach of the lower-income household, unless it was heavily subsidised. It was perhaps not generally realised that the advent of the oven thermostat enabled considerable departures to be made from the conventional design of electric ovens.

The heat capacity of the lagging and frame was responsible for the long pre-heating time. An oven had been constructed with a fairly thin liner in a sheet metal outer case with about ¾ in. of air lagging in between. Its pre-heating time was only half that of the conventional design of the same capacity. The watt loss to maintain any temperature within the cooking range was less than 10 per cent. in excess of the loss from the conventional cooker, with the result that there was an actual saving in kWh in the majority of cooking operations. Such an oven would be unsatisfactory with three-heat control, as the user would have to switch up and down so frequently for most cooking operations, but when fitted with a thermostat its operation was as simple and satisfactory as the best automatic oven of conventional design. Such an oven could be constructed very cheaply, even when fitted with a thermostat.

Assuming that the apparatus must be hired or sold at an economic price, one could develop load by offering a griller-boiler of an effective pattern, a low priced quick-boiling kettle without feet, so that it could be stood on top of the griller, and a separate oven built upon the lines indicated and upon which the griller could stand if desired. Each appliance should have a similar connecting socket so that one outlet and one plug and flex could serve each appliance in turn. The inability to use more than one appliance at once would not be a serious limitation and would avoid the need for a special circuit to be run. One advantage of such a combination would be that it could be purchased in stages.

Requirements Too Rigid

One of the functions of the testing department of a supply undertaking was the certification of meters. The amount of apparatus and instruments which the Commissioners specified for a testing station was not in any way unreasonable, but their rigid requirements as to type and performance of instruments were, in Mr. Howarth's view, unreasonable and unnecessary. They ruled out of use certain very good instruments and thus penalised well-equipped testing stations of long standing. There was a clause in the regulations which empowered the Commissioners to approve any instrument or apparatus which they deemed suitable for its purpose, but in practice they generally approved such apparatus for a limited term of years. They took no cognisance of the ability of the staff to use the apparatus properly, which was manifestly absurd. They endeavoured to ensure accuracy by regulations which imposed unnecessary restrictions upon testing stations that were well equipped and competently staffed, thus increasing the station's costs and at the same time reducing rather than increasing the accuracy with which they made their measurements.

When an examiner called to certify meters he used the station's wattmeter, and therefore checked the consistency rather than the accuracy of the meters. It would be more satisfactory if the examiner brought his own wattmeter, as his tests would then constitute a check upon the *accuracy* of the testing carried out in the station.

Many testing stations had the necessary equipment for checking wattmeters themselves to a sufficient degree of accuracy and it was an unnecessary hardship to have to send every substandard wattmeter to the N.P.L. It was a serious matter to send delicate instruments on a 400-mile journey and the risks were such that the instrument must be retested in the local station before it was put into use. Another difficulty was that an instrument might have a self-heating, or fatigue, or phase

defect which, while within the specified limits, might introduce errors in use. Manufacturers were usually quite willing to remedy these defects, but as it would involve reapproval by the N.P.L. at a cost of about half the price of the instrument, undertakings were likely to take the view that an instrument, having been officially approved, must be used as it was, and in consequence the accuracy of testing would be degraded.

It would, in Mr. Howarth's view, be more satisfactory, would cost the industry less, and would make for greater accuracy if the Commissioners would recognise a higher grade of testing station possessing suitable standards and an adequate and competent staff to use them. Such stations should be permitted to test their own sub-standard instruments, and those of other testing stations in the vicinity. This would reduce transport risks to the minimum. Some of the rules to which the examiners worked made one wonder whether the Commissioners had forgotten the limits of 2.5 per cent + and 3.5 per cent. − worked to on the ordinary commercial meter.

The importance of investigating the performance of domestic appliances which the undertaking sold or hired to its consumers could not be over-emphasised. Considerable skill and experience were necessary to enable satisfactory type and routine tests to be devised. In many cases the results could not be measured and it was difficult to devise methods of judging which were consistent and eliminated personal bias.

The testing department sometimes took a large share in staff training. It provided ideal experience for the trainee, and the varied nature of the duties enabled the qualities of trainees to be assessed with a fair degree of accuracy. The larger undertakings should seriously consider whether they could afford to acquire their staff in the old haphazard way.

The relationship between the supply engineer and the manufacturer of domestic appliances was in a different category from that between an ordinary maker and purchaser. The supply engineer was an intermediary between the manufacturer and the user, and the issue had been confused by subsidised hire schemes which had compelled the undertakings to pay great attention to reconditioning and this had had considerable influence upon their specified requirements. On the whole it had, perhaps, tended to limit the scope of the manufacturers and thus discourage the production of the cheaper type of appliance.

The quest for reliability and reconditioning facilities had overshadowed the requirements of the user to an extent which had definitely retarded the development of some appliances along lines which would best meet the needs of the user. Perhaps a good illustration of this tendency was the attitude of many supply undertakings and manufacturers to the thermostatic control of electric ovens. The undertakings feared to offer an improved oven lest it should make their existing cookers obsolete and thus involve them in loss. The manufacturers were equally reluctant to offer a facility which would compel them to redesign their ovens and thus render many of their patterns obsolete. The views of users were compelling both manufacturers and undertakings to substitute automatic oven control for the old-fashioned three-heat method.

It was the function of the supply engineer to ascertain what the user wanted and what he could afford to pay, and to pass the information on to the manufacturer. Co-operation between the two would result in the requirements of the user being met much more effectively than at present, and at an economic price.

Progress and Costs

THE continued upward trend of electricity supply was the theme of the inaugural address delivered by Mr. W. Dundas (Bradford Corporation) as chairman of the North Midland Centre of the Institution of Electrical Engineers at Leeds on October 21st.

Tabulated data compiled from statistics published by the Electricity Commissioners indicated the progress made during the past ten years and a comparison was made with development in America and other countries. Mr. Dundas said that the rate of increase of energy sold had remained fairly constant during the past four years and purchased energy had now assumed priority over private generation. Development in the domestic sphere was particularly noticeable and increasing in importance; traction load continued to make progress, while public lighting showed considerable increases. Lighting and domestic loads predominated in the case of the smaller undertakings, some of which offered attractive tariffs, but they exhibited greater divergence than those of the larger undertakings. The power load continued to absorb the major portion of the output and in this respect Mr. Dundas was optimistic regarding the outlook.

Elliott & Fry
Mr. W. Dundas

He estimated that 85 per cent. of the total number of consumers belonged to the domestic class. However satisfactory that might appear to be from one point of view, the same could not be said from the standpoint of the use made of the service, for the average consumption per consumer only amounted to 600 kWh per annum. An analysis of domestic consumers in the City of Bradford confirmed this low annual consumption of the average domestic user. Comparison of the foregoing with tests carried out in a house with 20 kW of installed capacity and an annual consumption of 4,652 kWh, together with records obtained from an estate of 300 houses, each with 10 kW of installed capacity and an average annual consumption of 1,360 kWh at a price of 0.733d. per kWh, clearly indicated the extent of the possibilities, especially when it was remembered that a relatively small proportion of houses possessed sufficient appliances to enable full advantage to be taken of the service available.

Mr. Dundas concluded that future developments would be governed largely by economic considerations, and much would depend upon the price of energy and the extent to which the service could be made to meet the needs of consumers. The fact that only limited use was being made of domestic appliances was illustrated by an investigation into average cooker consumption, which was found to be of the order of 800 kWh per annum. The speaker said that that figure was much less than he would have expected, judging by the quoted example of 1.5 kWh per person per day. At a cost of 1d. per kWh it could not be considered expensive and compared favourably with other methods of cooking. The low utilisation factor could hardly be attributed to high running cost with the low tariffs available in most places to-day, and that contention was supported by the results obtained in the case of comparatively small houses occupied by the artisan class. The spending power of the people was a factor to be taken into consideration, and it was estimated that 30 per cent. of the homes in this country could afford to take full advantage of the service and 70 per cent. or so of the remainder to a lesser extent, so there was every reason to believe that domestic consumption would increase well beyond the present average.

The facilities afforded for hire and hire-purchase of the more costly appliances were reflected in the increased use of cookers, water heaters, etc., and statistics showed that one out of seven domestic consumers cooked by electricity and 5 per cent. had installed water heaters, representing well over a million cookers and close on four hundred thousand water heaters in service to-day.

It was anticipated that electricity would only find favour in large scale heating of buildings in exceptional circumstances, on the score of cost, and in the case of dwelling-houses there was the added deterrent of the popularity of the open fire. On the other hand, occasional heating was an attractive proposition, and the popularity and convenience of the electric radiator was such that its use was likely to be considerably extended.

The examples given by Mr. Dundas showed that increased domestic consumption was accompanied by a higher maximum demand and lower diversity, which affected the cost so far as the supply authority was concerned, especially in distribution. The only methods of effecting improvements in that direction were either by controlling the load or reducing the loading of the heavier types of appliances, and neither method could be considered wholly satisfactory from the standpoint of service.

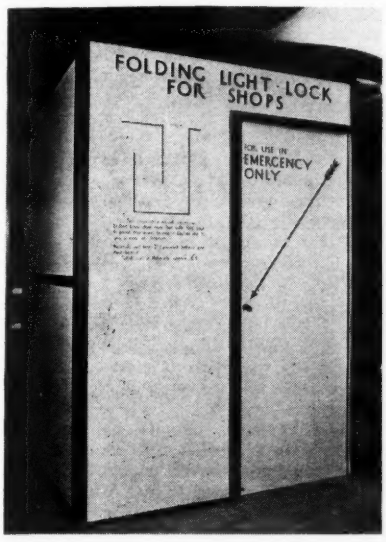
Production costs had been greatly reduced since the advent of the grid, but there did not seem to be much prospect of further reductions, which had been checked by the heavy increase in the price of coal. The burden of local rates added 15 per cent. to the working expenses, and the time was long overdue for a revision of what Mr. Dundas termed the present iniquitous method of assessment based on hypothetical tenancy.

The position with regard to cost of distribution gave rise to some concern, but the problem was not easily solved except at the expense of reliability of the service. The degree of reliability expected to-day was high, not only as regarded supply but also in servicing, which meant expense and must ultimately appear in the consumer's bill, but the desirability or otherwise of effecting economies in either of these directions was an open question.

A.R.P. LIGHTING

Exhibition at the Lighting Service Bureau

WITH a view to assisting the electrical industry and the public generally to adapt themselves to the new conditions of lighting brought about by the black-out the Electric Lamp Manufacturers' Association is now holding an exhibition at the Lighting Service Bureau, 2, Savoy Hill, London, W.C.2, at which a number of practical demonstrations can be given applicable to a variety of circumstances. While hints are given on problems of external illumination the point most stressed is that normal lighting should be used wherever practicable and that this can only be achieved with an effective black-out.



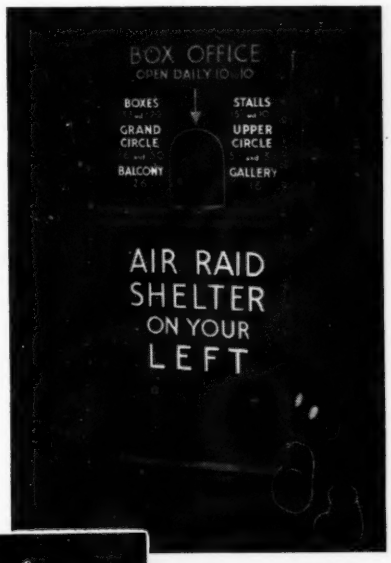
One of the E.L.M.A. light-locks

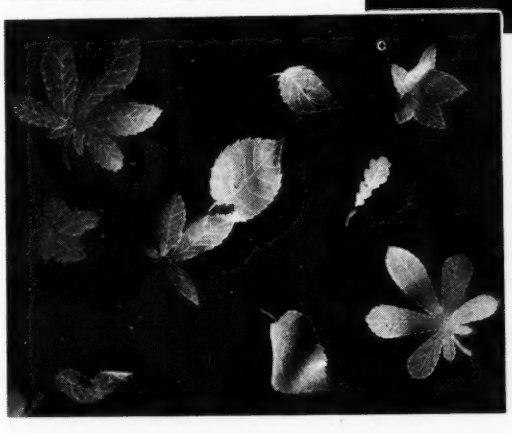
Accordingly the Association has prepared three typical light locks to meet the requirements of commercial premises. The first, which is provided with fluorescent directional signs, is constructed to BS/ARP 15 with certain alterations, making it considerably more practical. In the daytime its two walls fold back to give direct access to the shop and street, while at night the inside is enlivened by the introduction of fluorescent decoration, signs, &c., actuated by an 80-W ultra-violet lamp recessed in the ceiling of the main structure. There is a "panic door" for use in an emergency.

A "panic door," which has the function of giving easy access in daylight hours, is also a feature of a smaller and considerably simpler light lock. Let into it is a partially obscured glass panel, illuminated by the normal interior lighting, bearing the name and description of the shop. To overcome the objection by many shopkeepers to the ugly appearance of the light lock from inside the shop, one model is shown with a display space incorporated in the back. This display can be attractively illuminated without fear of the light penetrating into the street. An ingenious arrangement intended for really small shops has been constructed round a glass panelled shop door. The glass is obscured by black paint and a section of the lock constructed with a curtain. This curtain is operated by means of counterweights in such a way that when the door is closed the curtain is drawn back to allow free entrance to the shop interior.

Cinema, theatre and restaurant proprietors will be particularly interested in a display representing a cinema vestibule and illustrating the use of ultra-violet light and fluorescent materials. An illuminated pay-box, a fluorescent aquarium, flowers, leaves, &c., have all been constructed in the Bureau by a staff which has not previously handled the practical side of such work, indicating how an entire scheme of decoration could be changed easily and frequently at a very little cost. The fluorescence need in no way interfere with the structure or the normal decoration of the room.

A display of automobile headlamps and sidelamps and hand torches demonstrated in conjunction with a foot-candle meter gives some practical information on the much discussed subject of wartime restrictions of lighting on the road and, incidentally, emphasises the need for greater conformity in the amount of light permitted for sidelights and torches. In a room where demonstrations are given of the means of providing an even illumination of 0.002 or 0.02 ft.-candle in compliance with BS/ARP 16 and 20 the opportunity is also taken of showing lighting fittings suitable for use in properly blacked-out factories. Normal and emergency lighting of an air-raid shelter is also represented.



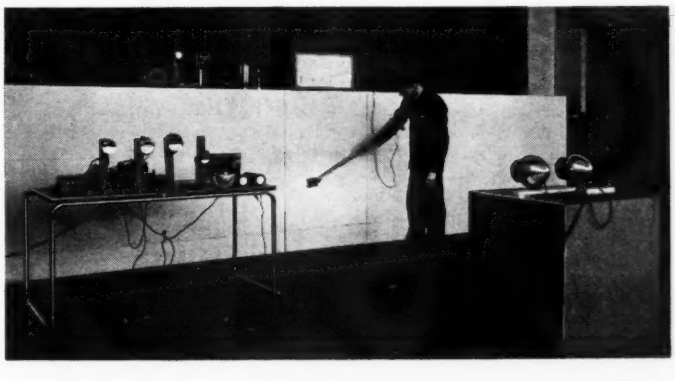


Fluorescent lighting of a cinema pay-box and (left) fluorescent leaves made of "Rhodoid"

E. L. M. A. points out that the employment of blue lamps in certain public places has conveyed the false impression that there is some particular virtue in blue light—a fact that has been long discounted. Furthermore, lamp manufacturers have been embarrassed by the enormous demand for 15-W lamps (the demand has risen from 5 to 30 per cent. of the total output) from householders who have not blacked out their houses efficiently.

Every effort is being made to meet this demand but to do so machines are being used which could otherwise be employed on work of national importance.

For this reason and also in the interests of their comfort and eyesight, householders should endeavour wherever possible to render their black-out arrangements so effective that the normal lighting and lamps can be retained. Moreover it is useless to imagine that a black-out compromise can be effected by using coloured or low-wattage lamps. Although at first glance it appears outside their province, the electrical trade must, for its own good, exert itself to assist the public to achieve an effective black-out.



Demonstrating the characteristics of a car headlamp mask

SERVING HEAVY INDUSTRY

Important Products and Processes

HOW much better off would this country have been if she had applied herself in peacetime to the manufacture at home of certain materials which play important parts in the heavier industries? An endeavour to indicate the answer to this question was made by Col. W. A. Bristow, M.I.E.E. (chairman and managing director of Low Temperature Carbonisation, Ltd.), who is a vice-president of the Institute of Fuel, in his inaugural address as president of the Fuel Luncheon Club in London on October 26th.

Col. Bristow first indicated some of the advantages of refining crude oil in this country, rather than importing the finished products, mentioning the valuable chemical by-products thus made available. Next he related how the establishment in this country of a calcium carbide industry, important though it was in itself, would stimulate other industries for which it would provide the raw materials. This industry's size and significance could be envisaged from the fact that the American Union Carbide and Carbon Corporation, which based its chemical production mainly on carbide, made in 1936 a net profit of $34,000,000, and operated in the United States and Canada more than 160 factories.

Another electro-thermal process similar to the carbide process was the manufacture of ferro-silicon which was an essential raw material for the steel industry; in 1937 this country imported 23,804 tons, mostly from Sweden.

The manufacture of carbide and ferro-silicon could be carried out in the same plant for an addition of only 30 per cent. to the capital cost, most of the plant being equally suitable for both products. This would enable the cost of production to be materially reduced in each case and if the plant were operated in conjunction with a suitable low temperature carbonisation plant, the overall economy would be still further increased.

Another and more important branch of the fuel industry which might have been attacked on a large scale was that known by the generic term "synthesis." Efforts were made in this country to enlist Government support for a full-scale trial of the Fischer-Tropsch process, but without success. By this process hydro-carbons were produced by the synthesis of hydrogen and carbon monoxide, the whole of the original coal converted, after being coked, into liquid fuels and valuable gases.

It was also important to remember that synthesis was not restricted merely to making oils and their derivatives. At higher pressures and with other catalysts carbon-monoxide and hydrogen combined to form methyl-alcohol which was the chief raw material for formaldehyde, the indispensable reagent in the manufacture of plastics; and other constituents of a large group of plastics were derived from coal in the form of phenols and cresols. The field for the future utilisation of coal along these lines was immense and many branches were still open for exploitation in this country. These processes and products were already commercially established on a large scale in other countries, but work now being carried out on these lines offered new and immense possibilities to the coal industry. For example, during the past few years the production of high octane petrol by polymerisation had become vitally important.

In this country five low-temperature plants alone yielded when in full production at least 25 million cu. ft. of methane per week. In addition, unlimited quantities of methane could be produced synthetically by the hydrogenation of coal with hydrogen or even steam at high pressures. The conversion of methane and the polymerisation of the conversion products into high octane petrols was the point towards which Col. Bristow hoped the coal and oil industries would converge.

In other parts of the Empire there were already valuable facilities for undertaking some of the work outlined and with our heavy and continuous adverse balance of trade, we could not afford to waste even a year before tackling these great tasks. What was it that stood in the way? Certainly not lack of skill, knowledge or courage. The system was to blame. There was no co-ordinated constructiveness in the fuel and chemical industries, almost complete absence of national planning by the many sections of the industry. Such things could not be left to chance and the occasional advances of lone adventurers. It was necessary for the State to establish a commercial research force, not only to undertake pure research and experimental work, but also to operate plants of ample capacity in order that processes could be brought to fruition. If these things were of vital importance to the future of this country and the Empire, then it was only logical that each should pay according to his ability as in the case of the other national services.

After the last war the collieries which had played such an important part in the allied victory were left to their fate and chaos and bankruptcy were narrowly averted. But what was going to happen after this war?

Much of the work Col. Bristow described had been carried out in Germany to prepare for war. Was it too much to ask that this country should show similar commercial courage and resolution in order to prepare for peace?

Electric Cremation Furnaces

THE first electric crematorium in this country was that put into service at Harrogate in February, 1937, at which time only two were in use on the Continent. Mr. Neil McLean, then borough electrical engineer at Harrogate, to whose initiative this pioneer development was due, has informed us that he considers the only obstacle to its wide use to be the high capital cost, *viz.*, about £2,000, between two and three times that of a gas-fired furnace.

On the other hand, £2,000 is only a small proportion of the cost of a whole crematorium and he believes that the advantages peculiar to the electrical method outweigh this drawback. Among these advantages are automatic temperature control, the saving in building costs due to the comparatively small stack required and the absence of chimney emissions.

In regard to the amount of electricity required, conditions at Harrogate are not such as to give the best results, as the number of cremations taken over a year averages only one per week; the consumption of 240 kWh per cremation is much higher than is being obtained from later installations, where the rate of use is a good deal higher.

Thus at Croydon, where an almost identical furnace was installed in June, 1937, cremations average one per day. Tests carried out in January, 1939, show that for thirty-three cremations the average consumption was 87 kWh each. As a result of satisfaction with this installation a second furnace has been erected at Croydon.

A fairer estimate of performance with more modern equipment is obtainable from the results being achieved at the new Hammersmith crematorium at Mortlake where "Birlec" furnaces have been installed as in the two previous cases. These were started up in January, 1939, and Birmingham Electric Furnaces state that the design is simpler and more robust than in the earlier models. Cast-grid heating elements operating at very low voltage are now employed and air-control valves on the side of the furnace have been eliminated, smoke control being effected by one master valve at the back.

In the subsequent three months 90 cremations were made with an average consumption of 36 kWh. No doubt the figure would have been lower still if only one furnace had been in use. As a result of experience the following results are anticipated: 150 kWh per cremation for 100 cremations per annum, 100 kWh for 200, 50 kWh for 300 and 30 kWh for 400 cremations per annum. Cremations have been carried out at Mortlake with the use of 6 to 10 kWh per cremation, when there has been more than one in a day.

A History of the I.E.E.

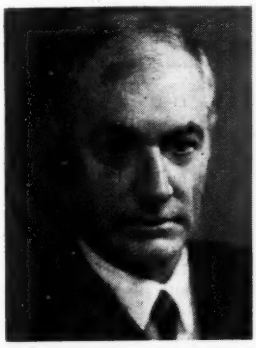
EARLY in 1937, the Council of the Institution of Electrical Engineers entrusted Commander Rollo Appleyard with the task of writing a history of the Institution, broadly speaking, from its foundation (as the Society of Telegraph Engineers) in 1871 to the centenary in 1931 of the discovery by Michael Faraday of the evolution of electricity from magnetism. The work has now been completed and the "History of the Institution of Electrical Engineers" is obtainable from the secretary in the form of a quarto volume of 342 pages and containing 38 plates, bound in full art canvas. The edition is limited and is available to the public at 18s. 6d. per copy, a price that only slightly exceeds the cost of production. To members of the I.E.E. (all classes) the price for one copy only will be 7s. 6d. provided it is ordered by November 15th (January 15th for overseas members). Extra copies or copies ordered after that date by members will cost 12s. 6d.

PERSONAL AND SOCIAL

Information regarding new appointments and other matters of interest for this page are welcomed

WE have had a letter from **Mr. E. M. Ackery,** who is in France, having exchanged the job of heating engineer to E.D.A. for that of flight-lieutenant in the R.A.F. He has had time to study electrical development in the village in which he is staying, and finds it to be extensive rather than intensive and somewhat below British standards. We wish him the best of luck.

Mr. W. Y. Anderson, M.I.E.E., has retired from the position of commercial engineer to the City of Birmingham Electric Supply Department, and to mark their appreciation of his services, Ald. Sir Percival Bower (chairman) on behalf of the Electric Supply Committee, has presented him with an illuminated copy on vellum of a congratulatory minute of the Committee. Mr. Anderson has also received gifts from his colleagues and the staff of the Department.



[H. J. Whitlock & Sons
Mr. W. Y. Anderson

Born at Tynemouth in 1874, he served his engineering apprenticeship with C. S. Swan & Hunter, and in 1896 joined Laird Bros., of Birkenhead, with whom he remained until 1900. He subsequently held positions with Bootle Cold Storage, Riverside Cold Storage, Vickers Sons & Maxim, and the Lancashire Electric Power Co., joining the commercial section of the Birmingham Electric Supply Department in 1907. He has contributed a number of articles to the ELECTRICAL REVIEW on such subjects as electric heating, electric motors in industry and the heat treatment of metals.

In our last issue we reported a number of changes in the directorial and managerial structure of Crompton Parkinson, Ltd., and its associated companies, and we now reproduce the portraits of the gentlemen concerned. Owing to a typographical error the name of Mr. B. Hallows Garside, who has been appointed to the board of Derby Cables, Ltd., was incorrectly given in our last issue.

Mr. R. C. Wood, chief electrician at Brodsworth Main Colliery, has retired. He served his apprenticeship with the General Electric Co., Ltd., at Manchester, and at the age of twenty-four was appointed electrical engineer in charge of five collieries at Eastwood, Notts. In 1905 he was set to supervise the installation of the electrical equipment at the sinking of Bentley Colliery, and two years later was appointed chief electrician at Brodsworth.

New directors of the Crompton Parkinson organisation showing (above) Messrs. C. F. Dickson and J. Harwood Fryer, A.C.A., (left) Col. C. Hardie, D.S.O., (right) Mr. T. H. Windibank, A.M.I.E.E. (executive directors of Crompton Parkinson, Ltd.), (Below) Mr. R. Weaving, M.I.E.E., appointed a director and general manager of the British Electric Transformer Co., Ltd., and Mr. B. Hallows Garside, elected to the board of Derby Cables, Ltd.

Mr. A. C. Owen has been appointed general manager of the Cornwall Electric Power Co., in succession to Mr. D. H. Kendon, who, as we have already reported has been appointed manager of the Shropshire, Worcestershire and Staffordshire Electric Power Co.

Mr. Donald Smeaton Munro, M.I.E.E. was married at St. George's West Church, Edinburgh, on October 21st to Miss Margaret Lamont Mackenzie, of Edinburgh.

Mr. R. Robinson, borough electrical engineer of Barnstaple, was married recently to Miss Irene Jenkins, of Barry.

Mr. S. R. Mellonie, M.I.E.E., A.Am.I.E.E., who has been with the Salford Corporation Electricity Department for the past ten years, has now been appointed distribution superintendent with that Department. Educated at the Manchester College of Technology and Northampton Polytechnic, London, Mr. Mellonie served his apprenticeship with Crompton & Co., and held appointments with the British Westinghouse Co., Wm. Geipel & Co., the British Thomson-Houston Co., J. H. Holmes & Co., the Admiralty, and the Metropolitan-Vickers Electrical Co., before joining the Salford Corporation Electricity Department. He has written a number of articles for the electrical Press, and in December, 1937, contributed an article to the ELECTRICAL REVIEW on "Internal Corrosion of Transformer Tanks." He has held lectureships in applied mathematics at the Marine School, South Shields, and in electrical engineering at Rutherford Technical College and Gateshead Technical College. Mr. Mellonie is a member of the North Western Centre Committee of the I.E.E., and a past chairman of the Manchester Technical Group of the E.P.E.A.

Elliott & Fry
Mr. S. R. Mellonie

Mr. O. Howarth, is the chairman of the North-Western Centre of the I.E.E. for the 1939-40 session, and elsewhere in this issue we give a summary of his address to the Centre. Mr. Howarth received his technical education at the College of Technology, Manchester, and obtained the City and Guilds first-class honours certificate in electrical engineering in 1909. He received his practical training with the General Electric Co., Ltd., and with Ferranti, Ltd. For ten years he was with the Manchester Corporation Electricity Testing Department, commencing as a tester and finally becoming chief assistant to the head of the department. For the past twenty years he has been with the Lancashire Electric Power Co., which he joined as meter engineer, and for fifteen years he has held the position of technical engineer and meter superintendent with that company. Mr. Howarth was chairman of the Meter and Instrument Section of the I.E.E. in 1935-36.

Employees of the Barnsley Corporation Electricity Department last Friday presented **Councillor** and **Mrs. H. M. Cassells** with a silver tea service in commemoration of their year of office as Mayor and Mayoress. Mr. Cassells' chief work

as a member of the Council has been in connection with the Electricity Committee, of which he has been chairman for twelve years. He is a member of the National Joint Board of Employers and Members of Staff of the Electric Supply Industry, and last year was appointed chairman of the Yorkshire area. Major E. A. Barker, borough electrical engineer, presided, and the presentation was made by the oldest employee of the Department, Mr. Arthur Atkinson.

Mr. R. H. Upton, M.Eng., A.M.I.E.E., A.M.I.Mech.E., has been appointed mains superintendent to the Borough of Ipswich Electric Supply and Transport Departments. Mr. Upton received his technical education at Liverpool University, where he obtained the degree of B.Eng. with honours, and subsequently received the degree of M.Eng. After serving his apprenticeship with Standard Telephones & Cables, Ltd., he entered the service of the Yorkshire Electric Power Co., in the Mains Construction and Operation Departments. In 1929 he was appointed assistant mains engineer in charge of the whole of the rural area of the York Corporation Electricity Department, and since 1933 has been mains superintendent to the Borough of Ealing Electricity Department. While at Ealing, Mr. Upton was given the added responsibility of engineer in charge of sub-stations. We regret that in our last issue we incorrectly stated that Mr. Upton had been appointed mains superintendent at Birkenhead, for which he had been recommended.

Elliott & Fry

Mr. R. H. Upton

Mr. A. G. Connell, M.I.Mech.E.,, A.M.I.E.E., F.Inst.P., whose presidential address to the Midland Branch of the Association of Mining Electrical Engineers is abstracted in this issue, is chief electrical engineer to the Staveley group of collieries, chemical works and foundries. Before taking up this position he was on the technical staff of Merz & McLellan. He is a member of the technical committee of four appointed by the Secretary for Mines to revise the Regulations for the use of Electricity in Mines.

Major R. J. Well, M.C., late employee managing director of Drake & Gorham, Ltd., has joined the board of directors of the Bective Electrical Co., Ltd.

OBITUARY

Mr. S. Y. Cooper.—We regret to learn of the death of Mr. S. Y. Cooper, who was formerly employed with the J. L. Eve Construction Co., Ltd. Mr. Cooper worked under the supervision of Mr. J. L. Eve from 1925 to 1936, during which time he carried out many important contracts. He was Mr. Eve's chief constructional engineer on the erection of the high river crossings in Scotland over the Rivers Cart, Clyde, Forth and Tay. He also constructed many miles of grid lines. Mr. Cooper had been in failing health for the last three or four years as a result of trouble incurred from a war wound.

Dr. R. V. Wheeler.—The death is announced of Dr. Richard Vernon Wheeler, Professor of Fuel Technology in the University of Sheffield, which occurred on October 28th, at the age of fifty-six. Dr. Wheeler, who was also Director of the Mines Department's research stations at Sheffield and Buxton, was educated at Plymouth College and Owens College, Manchester, and he was a Dalton Scholar and Fellow of Manchester University. He was a member of numerous technical bodies, including the Iron and Steel Institute, the Institution of Mining Engineers, the Institute of Fuel, the American Institute of Mining and Metallurgical Engineers, the Miners' Lamps Committee, and the Explosive in Mines Research Committee, and was president of the Midland Institute of Mining Engineers from 1929 to 1932. In February, 1938, he was awarded the gold medal of the Institution of Mining Engineers for outstanding work in the application of scientific knowledge to industrial problems, and last year he also received the Melchett Medal for services to science.

Parliamentary News

By Our Special Reporter

The Liverpool Black-out Lamp

IN the House of Commons on October 25th Mr. Thorne asked the Secretary of State for the Home Department if he could give any information in connection with the new black-out lamp invented by the Liverpool city electrical engineer.

Sir J. Anderson said that according to information supplied by the city electrical engineer, the illumination provided on the ground by this system of lighting was of much the same intensity as that used for the purpose of certain experiments recently undertaken by his direction and found then to be unsuitable from the point of view of the concealment of objectives from aircraft. He was, however, making further investigations into this experiment.

Gas and Electricity Rations

On October 26th Mr. Touche asked the Secretary for Mines whether, in view of the fact that gas and electricity users now had a 100 per cent. ration, he would consider the possibility of granting some additional allowance to households where neither gas nor electricity was used for cooking.

Mr. G. Lloyd said he would draw his hon. friend's attention to Article 5 of the Fuel and Lighting Order, which provided that extra allowances of coal might be granted by the Local Fuel Overseer in cases of necessity.

Mr. R. Duckworth asked the Secretary for Mines whether he was aware of the existing confusion over electricity rationing set up under the Fuel and Lighting Order; and whether, since consumers had had no official intimation as to how the scheme was to work, he would consider its postponement.

Mr. Lloyd said he was not prepared to postpone the order.

Street Lighting

Mr. Lipson asked the Home Secretary if he was now able to relax the restrictions on street lighting at least in areas where street lighting was controlled by a central control-switch.

Sir J. Anderson, in reply, said that it was only in a very few towns that all street lighting could be extinguished from a central control. Conversion of other lighting systems to enable the lamps to be extinguished centrally would involve many months of work and the expenditure of many millions of pounds. Moreover, more than half the street lighting in this country was by gas which could not generally be extinguished from a central point.

Even it if were possible, however, to extinguish street-lighting on receipt of an air-raid warning, there were still a number of considerations, of which account must be taken in, the interests of national safety, which suggested that it would be inexpedient to adopt this policy even in those few towns where a substantial proportion of the street lights were so controlled that they could be extinguished at a moment's notice. There were obvious disadvantages, and, as regards road traffic, even dangers, in a system by which some areas of a town would be brightly lit while others would remain in complete darkness. A sudden change from light to darkness would inevitably create very great confusion in transport services and would be very liable to cause panic in the streets. Moreover it had been conclusively established, by practical experiments carried out with the co-operation of the Royal Air Force, that ordinary street lighting, in a built-up area, or any system of street lighting of substantial intensity, would make the area visible to hostile aircraft from a distance varying according to weather conditions up to 40 miles.

These difficulties did not appear likely to be overcome by reducing the intensity of the street lighting—by using blue lamps or by screening such as was used in the last war—with a view to maintaining this reduced lighting until a public air-raid warning was given. In the meantime his Department was exploring the possibility of devising a type of modified street lighting of very low intensity which would not be visible by raiding aircraft and could be left alight even when a raid was in progress. The types of lighting so far tested had failed to satisfy the conditions required, and he could not hold out any definite hope at present that it would be found possible to devise a type of lighting which would prove satisfactory. Further experiments were in progress, however.

Electricity Price Control ?

During the Committee stage of the Price of Goods Bill in the House of Commons, Mr. E. Williams proposed that electricity, gas and water supplies should be included in the scope of the Bill.

The President of the Board of Trade said that this Bill was not the machinery for controlling the prices of such services but he undertook to see that no undue profit was made from them.

Electric Torch Prices

In reply to a question by Sir P. Hurd on October 31st, the President of the Board of Trade said that he had ascertained that the demand for electric torches far exceeded the supply. The increased prices were due, according to wholesalers, to the higher prices they themselves had to pay for home and imported torches. The price of the latter had risen by 100 per cent. or more. The application of the Prices of Goods Bill to torches and batteries would have to be considered in due course.

CORRESPONDENCE

Every letter must be accompanied by the writer's name and address preferably, but not necessarily, for publication. The Editors cannot accept responsibility for correspondents' opinions

"Keeping in Touch"

IN your editorial last week you quoted a remark from "The Electrical Power Engineer" that "the Journal may prove to be the only reliable means of keeping the members in touch with the Association's affairs." You appear to regard this as a slight upon the electrical Press, though no doubt an unintentional one. We wish to assure you that no slight was intended. No one appreciates better than electrical power engineers the assistance which is, and always has been, received from the electrical Press, and the valuable service they perform in keeping members in touch with one another and with current engineering activities.

What we had in mind when we wrote the above statement were the more intimate domestic affairs of the Association, information regarding which has in the past been disseminated in committees and at general meetings. If, owing to the exigencies of the war, such meetings become impossible, then the Journal will obviously have to be the vehicle for conveying this information. W. ARTHUR JONES.

London, S.W.1, *October 30th.* *Editor.*

Long Distance Transmission

In his excellent article in your issue of October 20th Mr. Rissik makes a statement in the first line of the second paragraph which seems to want the introduction of a specific distance to make it intelligible. Again, in line 17 of the same paragraph he states that it costs 0.1d. per kWh to transmit 450,000 kW over 600 miles at 400 kV, employing only a single line. We are afraid this would not be sufficient inducement to encourage transmission of power over 600 miles, unless the power was *very* cheap at the source, and unfortunately there are very few blocks of power of 900,000 kW (two circuits) that are so near to the centres of demand.

We have had occasion to consider, somewhat carefully, the transmission of over 2,000,000 kW (for "base-load" purposes only) from Bonneville, Oregon, to New York (2,400 miles) and we believe that this can be done with absolute transient and static stability, at a cost of the order of 0.035d. per kWh, if the power is cheap enough at the source. Over so short a distance as 600 miles, the cost would be only of the order of 0.009d. (at same voltage), so that the cost per kW-mile is about one-twentieth of that postulated by your contributor (taking his single-line figure as a term of comparison).

If this is so (as it certainly is), transmission of power from, say, the River Indus to Bombay, Calcutta and Madras, or from the Victoria Falls to Cape Town, or from Vereeniging to Cape Town (steam power) becomes possible. Moreover, the design is lightning proof, no matter how severe the stroke. (We run the lines from 20 to 50 miles apart.)

ECONOMIC TRANSMISSIONS, LTD.

Birmingham, *October 24th.* A. M. Taylor, *Director.*

Multiple-Earthed Neutrals

In your July 28th issue you published an article by Mr. T. C. Gilbert bearing the above title. The "box" in this article states that it is based mainly on American experience, but this does not apply to many of the facts quoted.

In the United States, 2,300-V, 2,300/4,000-V and 4,800-V circuits are generally used for urban distribution. At the present time about half of the urban distribution (2,300/4,000 V) in the United States is the multi-grounded or common-neutral type (multiple-earthed neutral). This form of distribution was first used on large systems twenty or twenty-five years ago and has been steadily gaining in usage since. In rural areas there has been a great expansion of electrical service in the past few years, mostly on the multi-grounded four-wire system (7,600/13,200 V) with single-phase extensions of one-phase wire and multi-grounded neutral. This system represents the major part of the construction of both the private power companies and of the co-operatives created under public auspices. Its safety as well as economy has been proven. The secondary systems, in general three-wire 115/230 V or four-wire 120/208-V circuits have been earthed at practically every customer's service entrance (multiple-earthed neutral) for twenty years, or longer, by practically all companies.

The most recent practice is to ground to a common ground at the service entrance, both the neutral of the service and the conduit where used. The grounding of the conduit and the neutral by means of the same electrode is a recent development. Previously, the neutral and conduit were separately grounded to water pipes where available and otherwise to individual ground rods.

At present there are proposals to modify the National Electrical Code to permit the use of bare neutral wiring in conduit or electrical metallic tubing, thin-wall conductors, increased conduit fill and covered neutral cable. The proposal to use bare neutral wiring is limited to rigid conduit and electric metallic tubing, which extensive tests show to result in a very small amount of by-pass current. Covered neutral cable proposed for use mainly in buildings of wood-frame construction consists essentially of a centre rubber-covered conductor and braid surround by a stranded neutral which, in turn, is surrounded by a number of layers of paper and then a high grade braid. Mechanical and electrical tests show that this covering withstands any abuses to which it may be subjected in service.

In Mr. Gilbert's article a point is made of the statements by the Chief Electrical Inspector of Evansville, Indiana. These statements were thoroughly investigated at the time of the Underwriters' Laboratories investigation and the only failure of bare neutral wiring which could be found was in the Sacred Heart Church. This failure was due to water in the conduit and was a failure of the insulation on the insulated conductor and no evidence of corrosion of the bare neutral conductor could be found, even with microscopic examination. According to the National Electrical Manufacturers' Association, the statements attributed to it by Mr. Gilbert were never authorised by the Codes and Standards Committee, which controls such statements.

Following the complaint of the American Water Works Association in 1931, the American Research Committee on Grounding was formed to study the alleged damage to water piping and its contents from electrical grounding. This committee formed under the auspices of the American Water Works Association and the Edison Electric Institute, has as well representatives of all other interested organisations. Its Technical Sub-committee through the past four years has investigated fifty odd individual cases where it was suspected that electrical grounding might have some adverse effect and presented the following summary of its work at a meeting last June:—

> "Various unsafe and unsatisfactory conditions have been revealed by the sub-committee. Many of these were in violation of established practice. However, to date the sub-committee has been unable to find any case where electrical grounding was shown to be a material factor in causing damage to water pipes or their content. The problem of obtaining and maintaining a satisfactory grounding attachment to the water pipe is noted in many instances. The most promising suggestion towards solving this problem is the installation at the time of construction of a special fitting in the water pipe near the water service entrance, to which a lug could be bolted by the electrician. The use of a jumper between pipes when gas or water meters are disconnected would substantially reduce the possibility of sparking or shock to workmen. Galvanic cells set up by dissimilar metals in the piping system appear to be an important factor in this problem. Minor impurities within the present specifications for copper used in piping or tubing appear to be a possible factor in the problem that is variously referred to as blue stain or green water. Where cement asbestos mains are used, the importance of the individual grounding connections becomes much greater. Also the importance of a continuous multi-grounded conductor increases in order to insure an overall low resistance ground for each service."

We have not had an opportunity actually to investigate the grounding situation in Australia to which Mr. Gilbert also refers. However, a number of Australian engineers have been in our office within the past year and have advised us that they favour the use of multi-grounding and that the trial installations of earth-leakage trips have not proved to be a satisfactory substitute for multi-grounding.

New York, *October 4th.* ALEXANDER MAXWELL,
Director of Engineering,
Edison Electric Institute.

[Mr. Maxwell's letter was sent to Mr. Gilbert who replies as follows.—EDS. ELEC. REV.]

I am sorry that Mr. Maxwell questions certain matters referred to in my article, as the information was afforded me from an unimpeachable source, which, unfortunately, I am not at liberty to disclose without reference. My infor-

mation concerning the Evansville experiment is to the effect that many buildings were later rewired with insulated neutrals, including the Bell Building, the Court House, and part of the Graham-Paige factory. The National Electrical Manufacturers' Association may not have authorised the quotation for publication, but I feel that it will not deny that it was made during an investigation into bare neutral wiring.

The advocates of bare-neutral wiring cannot have it both ways; if, as Mr. Maxwell states, there is a very small amount of by-pass current, then there must be a potential on the neutral, Ohm's Law not yet having been repealed and the current having to return to its source. If there is no neutral potential, then the whole of the current must be by-passed; there appears to be no middle way.

Reference to the American Water Works Association will elicit the reply that the present advocacy of bare neutral wiring is entirely at the behest of the supply interests, all other bodies apparently working in opposition. I have this information also upon unquestionable authority.

Mr. Maxwell's final paragraph is hardly fair comment as it is well known that the compulsory installation of earth-leakage circuit breakers in Australia is accompanied by direct earthing and in some cases combined with multiple-neutral earthing. In previous articles in this journal I have criticised this arrangement, and went so far as to foretell failure. I would refer Mr. Maxwell to your issue of June 17th, 1938, and an article entitled "Installation Protection in Australia," fully describing the method of installation, which is open to serious criticism.

T. C. GILBERT.

Folkestone, *October 25th.*

Transport in London

More Trolley-bus Passengers than Tram or Rail

ONE of the principal activities of the London Passenger Transport Board in recent years has been the conversion of its tramway system to trolley-bus operation, and at the end of the year covered by the Board's latest annual report—June 30th—the mileage of trolley-bus routes open for traffic had reached 236 compared with 198 miles a year before. In the same period the mileage of tram routes had been reduced from 175 to 135. At June 30th the Board owned 1,411 trolley-buses and 1,316 trams.

During the year the number of journeys made on the trolley-buses for the first time exceeded those on the trams, and, indeed, also on the railways, the respective numbers (in millions) being 570.6, 516.1 and 472.7, with 2,222.7 million journeys on buses and coaches. In the previous year the numbers were (again in millions): Trolley-buses, 367.7; trams, 700.9; railways, 487.7; and buses and coaches, 2,167.3. The decline in railway traffic was largely brought about by the closing of the under-river tunnels at Charing Cross during the crisis of September, 1938.

A Popular Vehicle

Within the period under review the Board's trolley-buses ran 55.3 million service car miles and the trams 57.5 million miles. Altogether, the service car mileage operated by the Board totalled 573.4 million, an increase of 6.3 million miles compared with the previous year. Of this improved service the trolley-buses were responsible for 3.1 million miles as a result of the closer service given compared with the displaced trams. Commenting on this, the report observes that "this closer service reaps its reward in an increased volume of passengers as the trolley-bus has proved a popular vehicle."

Financial statistics given in the report show that the Board spent last year £182,792 on the electrical equipment of trolley-bus routes, £1,020,273 on rolling stock and £247,793 on shops, works and depôts, making the total capital expenditure on trolley-buses at June 30th last £5,835,357. On the Board's railways a sum of £7,956,958 was spent during the year, raising the total capital expenditure to £89,480,002. Of the new outlay £1,959,495 was on lines open for traffic, £1,685,609 on lines not yet open for traffic, £4,136,362 on rolling stock and £175,492 on shops, works and depôts. A sum of £482,354 was also spent on electric power stations and distribution system, the total outlay on which was thus brought up to £9,938,959. The total energy supplied during the year was 756.2 million kWh against 735.8 million kWh in 1937-38, the cost per low-voltage kWh rising from 0.535d. to 0.569d.

Further capital expenditure authorised by the Board, mainly in respect of the new works programme 1935-40, is now subject to close review with the Ministry of Transport in the light of the changed circumstances arising from the outbreak of war.

The Bakerloo line will be projected to Stanmore this month, but the widening of the line between Harrow and Rickmansworth may now have to be postponed. A large part of the extension of the Central line, both on the east and west, will be ready for use in the summer of 1940. The extension from Highgate to East Finchley was opened on July 3rd last; the new station building at East Finchley will be completed by the end of this year and the new station at Highgate by next spring. It is hoped soon to make some extension of the service beyond East Finchley.

From a general point of view the past year was an unfortunate one for the Board. The rate of growth of traffic continued to decline, while the expenses increased substantially. The expenses of the main-line railway companies chargeable to the pool also increased and their passenger takings, which in previous years had consistently expanded, showed a small decrease, so that the sum which the Board received from the pool was appreciably less than in the previous year. As a result, the rate of interest paid on the London Transport "C" stock was 1½ per cent. compared with 4 per cent. in the previous year.

The total number of passengers carried on the Board's system was 3,872 million, an increase of 58 million. Adding the passengers carried on the suburban lines of the main-line railways, the total number of passengers carried within the London Passenger Transport Area was 4,369 million, an increase of 51 million. The average number of rides per head of the population served was 444 compared with 441 in the previous year.

The Board's total traffic receipts, after the operation of the pooling scheme, amounted to £31,069,753, an increase of £145,925. The average receipt per passenger journey for all passengers covered by the scheme was 2.332d., or 0.009d. less than in the previous year. Working expenses, excluding provision for renewal, amounted to £25,140,163, an increase of £216,907 compared with the previous year. Thus it will be seen that working expenses have increased at a greater rate than traffic receipts. Total payments in respect of staff amounted to £17,629,038, or over 70 per cent. of the working expenses, salaries and wages increasing by £180,665 during the year, mainly due to improvements in the wages of the lower paid staff on the railways and in the rates of pay of drivers and conductors of trams and trolley-buses. The total sum available for appropriation was £4,795,787, and for the service of the "C" stock there was £411,128, a decrease of £643,026.

Effect of Revised Fares

Revised fares were introduced on June 11th last. It was estimated that in a full year the Board's proportion of increased fares in the London Passenger Transport Area would produce additional revenue of £732,000, and in the first two months of the current financial year the results so far as the Board is concerned, were at least equal to this estimate.

With regard to air-raid precautions, the Board has taken all necessary steps to ensure the maintenance of essential railway services in the event of hostile attack, including the installation of floodgates at many points on the railways to protect them against the possibility of flooding. At June 30th the total expenditure incurred on air-raid precautions was approximately £422,000. Of this sum £143,963 represented expenditure on "good employer" works, of which the larger part will fall to be borne by the Board.

The Board's staff at the close of the year under review numbered 86,456 and the average earnings of the weekly paid staff were £4 2s. 10d. The Ministry of Transport has been pursuing the problem of the staggering of business hours with large employers of labour. As a contribution to its solution, the Board has altered the hours of attendance of the staff at certain of their offices, with successful results.

Coal Utilisation Joint Council

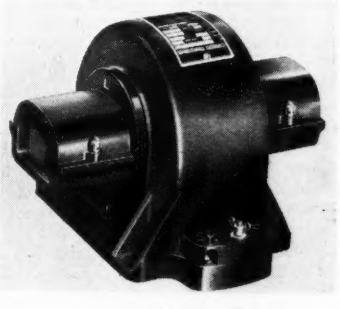
At a meeting of the Coal Utilisation Council held on October 26th a resolution was formally passed winding up the Council and intimating that its functions would be taken over by the Coal Utilisation Joint Council, a new body on which, in addition to the colliery owners and coal traders, the coal-burning appliance manufacturers and distributors would also be represented. The scope of the work will be curtailed in some respects during the continuance of the present national emergency, but essential services will be carried on by the new body. Communications should be addressed to Mr. J. S. Williams, secretary, Coal Utilisation Joint Council, Grosvenor Gardens House, Victoria, London, S.W.1.

NEW ELECTRICAL PRODUCTS

A Review of Equipment Recently Marketed

Current Transformers

A NEW range of bakelite-housed and all-insulated, totally enclosed instrument transformers has been produced by SANGAMO WESTON, LTD., Great Cambridge Road, Enfield, to supersede all its existing types of transformers. These new patterns have been designed to cover a wide range of accuracies specified by the British Standards Institution and have a construction giving remarkable mechanical strength and electrical performance, the windings being toroidally wound on ring type cores of high permeability low loss nickel-iron alloy.



Sangamo Weston "S2" current transformer

By means of a combination terminal block and automatic short-circuiting device provided on all models, the secondary leads can be disconnected from the secondary terminals with complete safety while the transformer is on load. The transformers, which conform with B.S.S. No. 81—1936, are small, light and extremely neat in appearance and they are subjected to rigid tests at all stages of manufacture.

In the "S1" model the coils are enclosed in a specially designed moisture-proof housing of all-insulated moulded bakelite, so avoiding the necessity for earthing. The outstanding feature of the "S2" model is that in addition to being all-insulated it is totally enclosed.

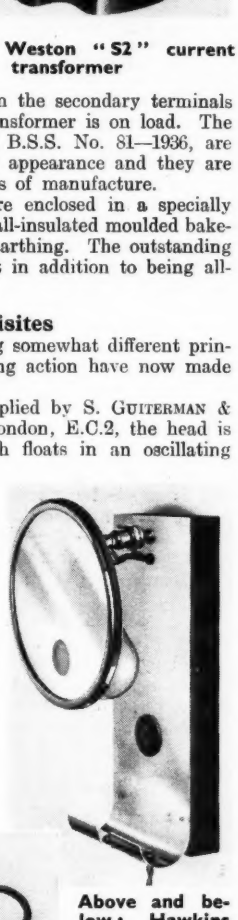
Toilet Requisites

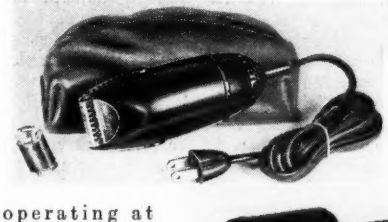
Two new electric razors involving somewhat different principles from the customary oscillating action have now made their appearance.

In one, the "Shavemaster," supplied by S. GUITERMAN & CO., LTD., 35-36, Aldermanbury, London, E.C.2, the head is semi-circular and the cutter, which floats in an oscillating holder, operates in over-and-back, half-circle action. Centrifugal force presses the cutting edge against the inside of a thin steel comb which fits over the cutter.

The surface of the comb, except for the clipper openings at the ends, is a network of very fine holes into which the hairs enter as the shaver is passed over the face. The action of the blade is self-honing, while the bronze bearings have sealed-in oil wicks. The heavy streamlined bakelite housing incorporates a switch at the rear end.

A round head with a rotary blade





Above and below: Hawkins shaving mirror and shaver. Left: the "Shavemaster"

operating at 4,000-5,000 RPM is the feature of the other machine, the "Casco," supplied by L. G. HAWKINS & CO., LTD., 30-35, Drury Lane, London, W.C.2. The cutter head has sixty-six slots into which the hairs are drawn. A bakelite blade holder insulates the head from the motor, the frame of which is also of bakelite. The case is of "Tenite." Self-lubricating bearings and an on-off switch are also provided in this model.

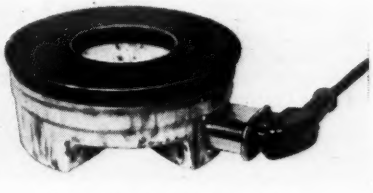
For use in conjunction with electric razors the same company has brought out a special illuminated mirror incorporating a plug and a rack. The mirror will also be appreciated by the womenfolk for it provides a convenient point to which a hair dryer, curling-tongs, &c., may be connected.

Similar facilities for the use of razor, hair dryer, &c., are available in the "Davey" electric bathroom cabinet brought out by A. D. DAVIDSON ELECTRIC CO., 82½, Hurst Street, Birmingham. This too is illuminated, a 15-W lamp not only lighting the plate glass mirror but also preventing it from becoming steamy.

Small Boiling Ring

Quick heating and exceptional heat storage properties are the outstanding features of the "Elco Junior" boiling ring manufactured by ELCO (TREFOREST), LTD., Treforest Trading Estate, near Cardiff, and distributed in England by the INTEX ENGINEERING CO., LTD., 15, Dartmouth Street, London, S.W.1.

With a loading of only 650 W the apparatus will boil two pints of water in about twelve minutes, the efficiency reaching 70 to 75 per cent., according to the utensils used. Surface temperature will not exceed 1,200 deg. F. even without utensils.



"Elco Junior" boiling ring

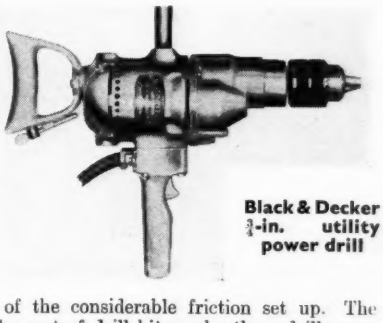
The mounting of the element, which is of the ring type designed to combine efficiency with long life, on a ceramic base not only contributes to the neat and pleasing appearance of the ring but ensures the highest degree of safety. The manufacturers of the apparatus are hoping to put a range of hotplates and portable cookers on the market shortly.

Chromium-plated Toasters

BROWN BROTHERS, LTD., Browns Buildings, Great Eastern Street, London, E.C.2, announce that their "Duco" electric toaster, which hitherto has been available only in nickel plate, can now be obtained in chromium finish at the same price. Both models have loadings of 600 W.

All-purpose Drills

Three new utility power drills have been produced by BLACK & DECKER, LTD., Slough, to meet the insistent demand for low-priced all-purpose drills, particularly where a heavy torque is required. While retaining the general features of the earlier models, they have lower speeds for chuck capacities than the ratios generally used on these sizes of drills, thus enabling them to be employed with carbon-steel bits instead of the usual high-speed drill bits. Where high-speed electric drills are used with carbon-steel bits there is a tendency for the cutting edge of the bit to become burnt and burred as a result of the considerable friction set up. The obvious saving in the cost of drill bits make these drills very economical in use.



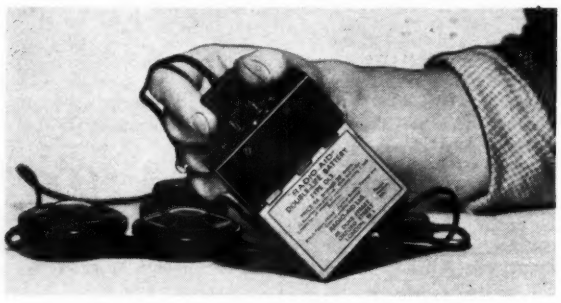
Black & Decker ¾-in. utility power drill

A generously proportioned triple reduction gearbox and a large sized armature pinion are both made from special heat-treated nickel-chrome molybdenum steel. Although designed to withstand exceptional wear, these units have been made lighter and easier to handle than former models, and for safety they are fitted with double pole automatic release trigger switches.

Other features of the drills are ball-bearing mountings for the motor, which on all models operates on either DC or AC and taper roller bearings for the main spindle. The whole of the range has been so designed as to give ample overload capacities.

Hearing Aid Batteries

Until recently a user of a hearing aid has, on account of the size of the plug fitted, been able to obtain supplies of the necessary batteries only from the makers of his own instrument. Consequently, with the relatively few batteries sold by each manufacturer and with the cost of the terminal fitting amounting to a substantial part of the cost, the price asked for the battery appears large in comparison with regular lines of commercial batteries. RADIO-AID, LTD., 88, Wigmore Street, London, W.1, however, has now introduced an adaptor which enables a standard battery to be employed.

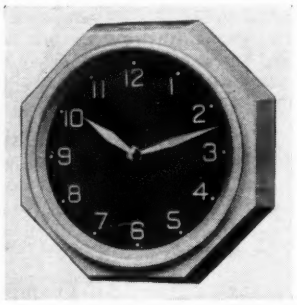


Radio-Aid double-life battery and adaptor

A further saving in maintenance is also provided by a booster cell which is claimed to double the life of any cell. Deaf aids of the general micro-telephone type work best at a particular voltage. The booster cell helps to maintain this and thus lengthens the life of the battery.

All-metal Laminated Gaskets

Features claimed for the "Dickson" all-metal laminated gasket just marketed by HOWARD CLAYTON-WRIGHT, LTD., are that it is leak and blow-out proof; makes and remains a perfect seal for both hot or cold joints after continuous heating and cooling; seals extremely high pressures; prevents distortion; provides immediate heat transfer between parts sealed (asbestos types are all non-conductors to heat); cushions and absorbs vibration; prevents cracking of cylinder heads, blocks, flanged joints, &c.; will seal with less pressure than is required for the ordinary soft-centred type of gasket; the exact dimensions are maintained uniformly throughout; and it is not necessary to use cement, adhesives or any kind of sealing compound in fitting it. The gasket consists of a number of metallic laminations, different combinations of metal being used for different conditions.

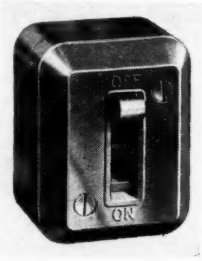


New Gent clock

A.C. Switches

Such success has attended the introduction of the "Wylex" AC switch in the "Wylexion" (BSS 546) and "Wylex" (flat-pin) sockets that GEORGE H. SCHOLES & CO., LTD., Wylex Works, Wythenshawe, Manchester, have now produced the switch as a separate unit in both single- and double-pole types. It is a slow-break unit with silvered contacts and even on considerable overload gives a remarkable performance.

It is compact and pleasing in appearance and is easily fixed. There are only two moving parts, the dolly and the contacting bar, and the metal parts are machined out of solid brass, the switch being therefore exceedingly robust. The totally enclosed construction excludes all dust and dirt.

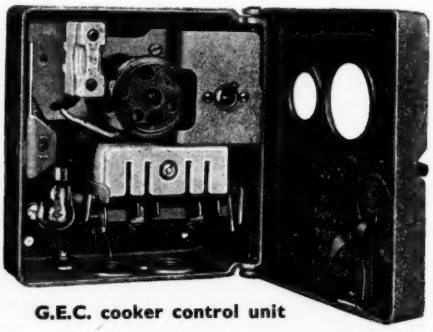


"Wylex" AC switch

Cooker Control Units

New 30-A, 250-V cooker control units, fitted with both mechanical and luminous indication and having a pleasing appearance suitable for modern kitchens are now manufactured by the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2, with 5-A or 15-A sub-circuits.

The unit is housed in a cast-iron case with mottled sprayed finish. A special patented indicator displays a black disc for the "off" and a red for the "on" position. Luminous indication can also be provided, if required, since the red disc is made of translucent material, behind which is a socket for a lamp.



G.E.C. cooker control unit

The operating mechanism of the indicator is secured to the lid of the case and provides a locking device supplementary to that of the switch handle interlock.

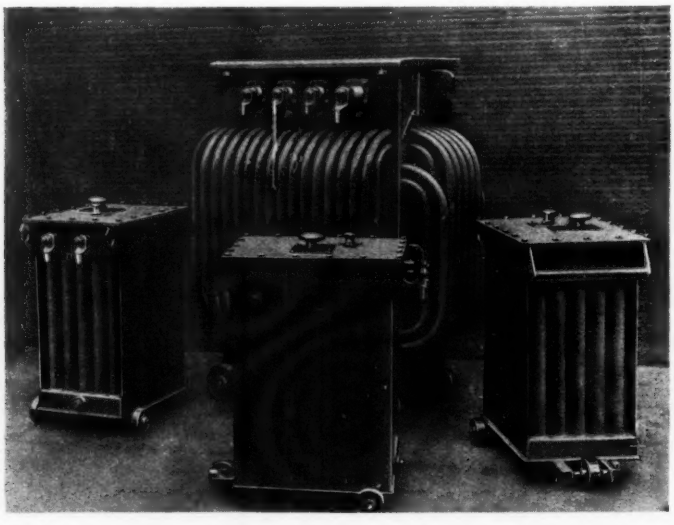
The sub-circuit socket outlet is of the damper shutter type controlled by a d.p. switch. In the standard pattern one fuse only is supplied controlling the socket and lampholder, but if required an extra fuse assembly can be fitted, allowing socket and lampholder to be used separately. The switch contacts are shielded, and both external and internal earth screws are provided on the case.

AC Arc Welding Equipment

Special features of design of AC arc welding equipment developed by BONAR LONG & CO., LTD., Princes Street Works, Dundee, ensure consistency of welding deposit by preventing the transient voltage variations which make it difficult for the operator to control the slag and impede correct metal fusion. The plant has a drooping voltage characteristic which automatically adjusts the arc voltage to suit the particular grade and size of electrode being used. This obviates the provision of external voltage adjustment regulators.

Control of the welding current output by means of an externally operated tapping switch is simple and foolproof and no damage will be done if the tapping switch is operated on load. As the equipment is designed so that the maximum short-circuit current is not more than 20 per cent higher than the normal welding current for each tapping setting, it is completely self-protecting even in the event of a prolonged short-circuit such as may occur through a faulty trailing cable. Moreover, the plant will not impose any abnormal or heavy fluctuating load on the supply mains.

Maintenance costs are claimed by the manufacturers to be practically neligible. There are no rotating parts and the only attention required is the occasional changing of the oil in which the equipment is immersed. Both single- and multi-operator sets are available, the latter being designed so as to eliminate electrical interference between operators.



This three-operator AC arc welding set made by Bonar Long with an output of 600 A per operator is claimed to be the highest output plant so far manufactured in this country

COMMERCIAL and INDUSTRIAL NEWS

Duty-free Machinery Imports. New Zealand Trade Restrictions. Prohibited Imports. Diesel-electric Car Order. Copper Purchases from Canada.

Overseas Electrical Trade in September

A SUMMARY of the overseas trade of Great Britain during September, the first month of the war, has been issued by the Board of Trade in place of the usual detailed analysis. Exports of electrical goods and apparatus dropped in value from £1,030,708 in September, 1938, to £566,518 this year, and the value of machinery exports (including electrical) fell from £4,471,846 to £2,259,796. Imports of electrical goods and apparatus were more than halved, decreasing from £259,239 to £124,888, but machinery imports were only 13 per cent. less than a year ago—£1,418,660 against £1,634,956.

Duty Free Machinery Imports

The Treasury is prepared in approved cases to issue licences for the importation free of any or all import duties of definite consignments of machines of certain classes including the following:—Machine tools, metal working and finishing and woodworking machinery; battery-making machinery; glass-making and working machinery and electric lamp- and valve-making machinery; wire-working and wire-winding machinery; presses; and blast-furnace, smelting, metal refining and foundry machinery. Applications must normally be made by the actual or prospective user, but in certain circumstances applications by importers will be accepted. Application forms may be obtained from the Import Licensing Department, Board of Trade, 25, Southampton Buildings, W.C.2. For machine tools only forms are obtainable from the Controller of Machine Tools, Ministry of Supply, 14, Tothill Street, S.W.1.

New Zealand Import Licences

The *Board of Trade Journal* publishes particulars of the licensing of imports by the New Zealand Government for the first half of 1940. Licences will be issued generally on the basis of imports during the corresponding period of 1938 and importation will be permitted not later than August 31st, 1940. No relaxation of restrictions has been made and importers must apply to Reserve Bank for remittance authorities as heretofore, which are expected to be granted as required but not later than August 31st, 1940.

Importation of the following goods is prohibited from all sources:—Transformers, reactance and choking coils suited for use in wireless sets; batteries or cells (not including storage batteries); radio receiving sets mounted in cabinets; electric irons; insulators; vacuum cleaners; and electric cooking and heating appliances. Importation of the following goods is restricted by 50 per cent. in the case of the United Kingdom and by varying percentages in the case of other sources:—Tariff item 338. Machinery or appliances, electrical, *viz.*: *ex* (3) electrodes for electric welding; *ex* (10) (b) n.e.i. except insulators. 339. Incandescent filament electric lamp bulbs, having a marked voltage, not being peculiar to surgical use. 340. Electric lamps, n.e.i., not being peculiar to surgical use.

Non-ferrous Metals Control

In pursuance of Regulations 55 and 98 of the Defence Regulations, 1939, the Minister of Supply has issued the Control of Non-Ferrous Metals (No. 4) Order, 1939 (October 23, 1939). This Order amends the schedule of maximum prices attached to the Non-Ferrous Metals (No. 2) Order, 1939, (i) by removing from it zinc sulphide, lithopone and zinc dust; (ii) by increasing the maximum prices for zinc oxide (Red Seal quality), zinc sheets and zinc boiler plates, and adjusting the price of hard spelter and dross for delivery on an "ex works" basis; and (iii) by fixing for the first time maximum prices for various forms of non-ferrous scrap. As regards zinc sulphide and lithopone, arrangements are being made with the trade for the regulation of the prices of these materials on a voluntary basis. The Order also removes the necessity for sellers or purchasers of zinc oxide, zinc carbonate or zinc dust to obtain licences under Article 2 of the Non-Ferrous Metals (No. 3) Order, 1939. Copies of the Order in question may be purchased directly from H.M. Stationery Office or through any bookseller.

Prohibited Imports

By the Import Prohibition (No. 4) Order, 1939, the importation of further classes of goods is forbidden save under licences issued by the Import Licensing Department of the Board of Trade. The following electrical goods are scheduled:—Battery-charging sets; condensers; convertors and transformers; electric heating and cooking apparatus; electro-medical apparatus; generators and parts; magnetos; meters; motors and parts; portable mechanical appliances, electrically driven; starting and controlling gear and parts therefor; switchgear and parts therefor; and telegraph and telephone apparatus.

Goods which had been dispatched to the United Kingdom before the date on which the Order came into force (October 25th) are exempt from the provisions of the Order. In respect of any other specified goods importers are warned that they should not arrange to ship until they have obtained a licence or have definitely ascertained that one will be available. In coming to a decision regarding the issue of a licence the Department is guided by two main considerations:—(1) Whether the equivalent is obtainable in this country; and (2) the general desirability of deferring the importation of goods which are not required for work of national importance.

Diesel-electric Cars for Ceylon

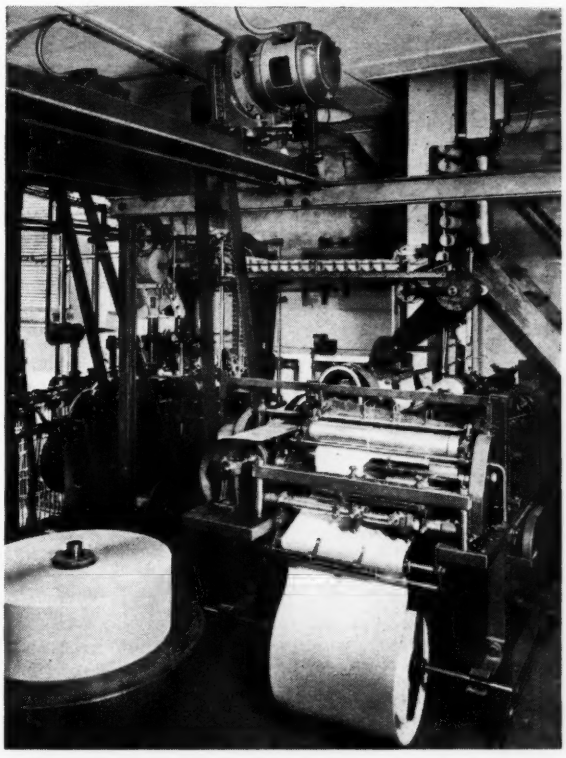
The English Electric Co., Ltd., has received from the Crown Agents for the Colonies an order for eight Diesel-electric rail-cars for the Ceylon Government Railways. This contract follows the successful running and operation of the four-coach Diesel trains which the company supplied to the Ceylon Government in 1937. The new order is for single cars, but the power equipment, which consists of "6H" type engines developing 180-200 HP at 1,350 RPM and electrical transmission, will be interchangeable with the power equipments in the four-coach trains. Each car will seat seventy-eight passengers and will be of the most modern welded-steel construction. The complete vehicles are being built in the works of the English Electric Co.

Iron and Steel Scrap

The Iron & Steel Control of the Ministry of Supply (Steel House, Tothill St., S.W.1) has circulated a letter to firms in trades which are likely to have quantities of scrap iron and steel for disposal. It points out the importance of collecting and disposing in the proper quarters of all discarded material of this nature. A postcard enclosed with the letter enables firms to obtain from the Control advice as to the disposal of scrap or report how much they have disposed of.

Electric Drive in a Milk Carton Factory

The Cambrian United Dairies, Ltd., of Cardiff, has created a carton production department, the equipment for which possesses many features of interest. The machines employed



Winding machine at the Cambrian United Dairies, Ltd., driven by a G.E.C. squirrel cage motor

are of a novel design, not previously employed in this country, which enables the cartons to be constructed, filled and sealed in a continuous series of operations.

The paper is supplied in reels and is first passed through a grinding machine which chamfers the edge so as to ensure a thin, smooth joint at the overlap on the finished carton. The reels are then transferred to the winder where they are cut into correct lengths, which are wound on a mandrel and fastened with a casein adhesive. The name and trade mark are printed on during this operation, and the resulting cylin-

ders of paper are carried on a conveyor through a hot air chamber in order to dry the adhesive. An overhead conveyor then takes the finished cylinders to the assembly machine where the bottoms and covers are pressed on in four operations. The winder is driven through reduction gearing and belt from a 1½-HP 980-RPM squirrel cage motor mounted above on the girder. A small squirrel cage motor drives the suction pump, which is connected by an air line to the travelling plate and serves to hold the individual lengths of paper on it while they are carried across to the mandrel. The grinder is driven by a 1-HP 940-RPM squirrel cage motor while a press which punches the tops and bottoms for the cartons out of cardboard strip is belt driven from a 4-HP squirrel cage motor, 940 RPM. The assembly machine is driven by means of belts from two 2-HP squirrel cage motors, 980 RPM, mounted on the girder, one motor being directly behind the other. A conveyor brings the tops and bottoms from the press; these are fed into a chute, and travel down with the paper cylinders to which they are subsequently fitted. The finished cartons are delivered into a basket, and from here they are collected and placed in a travelling chain conveyor, which carries them to the churns for filling. The motors, which are designed for a 440-V 50-cycle three-phase supply, are provided with direct-to-line starters controlled by push-buttons. Both motors and control gear were manufactured by the General Electric Co., Ltd.

Traffic Control in Melbourne

A step forward in street traffic control is being taken by the authorities in Melbourne, Australia, where co-ordination of control is being effected over an extensive area embracing twenty-five road intersections. Equipment is being manufactured by the Automatic Telephone & Electric Co., Ltd., for Amalgamated Wireless (Australasia), Ltd., the suppliers, and is of the "Electro-matic" type with linking between the various intersections imposed by means of master timers.

Standardisation in France

The outbreak of war has considerably increased the activity of the French Standards Association (Afnor), and every effort is to be made to increase both the number and the utilisation of standards in all lines of manufacturing. Factories are being urged, whenever possible, to make use of existing standards. It is pointed out that in wartime, with the danger of possible destruction or transformation of factories, only the use of standard dimensions and characteristics for the parts of apparatus permits the replacement of parts, if the original manufacturer of non-standard parts finds himself unable to replace them. Moreover, the use of standard characteristics speeds up production. As a matter of urgency, Afnor is to study standards for material required for war purposes, but so far as is possible, this period is also to be utilised for the creation of industrial standards for normal purposes. This new impetus to standardisation is expected to prove of particular interest to the electrical industries where much still remains to be done.

Canadian Copper Contracts

The Canadian Prime Minister's Office announces that contracts have been concluded between the British Ministry of Supply and leading Canadian copper producers for the supply to Great Britain of 420,000,000 lb. of electrolytic copper over an approximate period of one year. The amount represents about 80 per cent. of current Canadian output, states the Ottawa correspondent of *The Times*. The price will be about that ruling at the outbreak of war, and payment will be made in Canadian currency. The contracts are subject to renewal for the duration of the war. International Nickel has been allocated 237,700,000 lb., Noranda 75,000,000 lb., and other companies smaller amounts.

Lamp Manufacture in Australia

The equipment of a factory is now being completed for the manufacture of "Ensign" lamps at Melbourne, Australia. A new company has been formed, the controlling interest being held by the English company. Edmunds Bros. (Pty.), Ltd., who in the past have been responsible for "Ensign" sales in Australia, are fully represented on the board. Expert staff has been sent from Preston to form the nucleus of works personnel. The sales policy in Australia will follow closely similar lines to that operated by the parent company.

Trade Announcements

It is announced that for the duration of hostilities the General Electric Co., Ltd., has taken over the sales of the all-purpose conduit boxes made by Corbelux, Ltd. Ample stocks are available at all G.E.C. branches and depôts.

James J. Hyde, Ltd., have removed from 36 to 38, Bedford Street (ground floor), Belfast, as from November 1st.

Radio Lectures

A course of lectures to meet the needs of students and others who may wish to qualify themselves for possible future service in radio branches of the Defence Forces is being given at the Royal Institution. On Tuesday last Prof. C. L. Fortescue gave the first of four lectures on "Modern Radio Apparatus and Installations." The second was to be given yesterday (Thursday), and the remaining lectures will be given on November 7th and 9th. Commencing on November 14th four lectures will be given by Dr. R. L. Smith-Rose on "Transmission of Radio Waves over the Ground and Direction Finding." The other dates are November 16th, 21st and 23rd. Four lectures are also to be given by Dr. E. V. Appleton, his subject being "The Transmission of Radio Waves Through the Atmosphere." The first lecture will be given on December 6th and the others on December 8th, 13th and 15th.

Tickets (free) may be obtained from the General Secretary of the Royal Institution, 21, Albemarle Street, London, W.1.

Warehouse Selling

Many books have been written on salesmanship for the retailer and the commercial traveller, but little has appeared for the guidance of the assistant working in the sales department of a manufacturing or wholesale firm. In "Warehouse Selling" (The Burlton Institute, 30, Manchester Street, London, W.1, price 2s. 6d.), Miss Gladys Burlton gives useful hints for the sales staff of a wholesale warehouse or factory. After dealing with the work of the indoor sales staff, Miss Burlton stresses the importance of the method of receiving customers and outlines some of the pitfalls. There are also chapters on salesmanship and the technical knowledge required by a good salesman.

Engineers' Wages

A meeting between representatives of the Amalgamated Engineering Union and the Engineering and Allied Employers' National Federation was to be held yesterday (Thursday), for an informal discussion having regard to the fact that, according to the practice of the industry, the advance of wages last June would normally preclude the reopening of wage discussions within six months.

On Monday last the Confederation of Shipbuilding and Engineering Unions applied to the engineering employers for a meeting in order to raise the question of wages in view of the higher cost of living. A meeting between the Confederation and the Shipbuilding Employers' Federation was to be held in Carlisle yesterday (Thursday) to discuss a number of matters connected with war requirements, including hours of labour and output.

Canteens in Industry

The Industrial Welfare Society has issued a book entitled "Canteens in Industry" (price 1s.), in which it outlines the planning and erection of canteens for the use of employees. The greater part of the publication was prepared before the outbreak of hostilities, and as a consequence many points, such as the restrictions on the supplies of certain types of food, and supplies for building and equipment, which will become important later in the war, have been omitted. The majority of the matter, however, is equally applicable to the establishment and management of canteens in both war or peace. Information is given on the internal construction, lighting, heating and ventilation of canteen premises, the layout of the kitchen and choice of fuels, management and service, and the law relating to works canteens.

New Falkirk Showrooms

Falkirk Corporation Electricity Committee recommends the Town Council to borrow £6,000 for new electricity showrooms.

Liverpool Electrical Contracts

Mr. P. J. Robinson, Liverpool city electrical engineer, has reported to the Civil Defence Emergency Committee that forty-five concerns have notified him that it has been necessary to increase prices on existing contracts, the increases ranging from 5 to 50 per cent.

South African Imports from U.S.A.

According to *U.S. Commerce Reports* electrical machinery and material to a value (at 5 dollars to the £) of £1,535,000 was exported from the United States to South Africa during last year as compared with £1,845,200 in 1937. It is pointed out that the war in Europe, if prolonged, may affect the market in South Africa materially owing to the fact that shipments to the Union from the United Kingdom and other major supplying countries will be curtailed. As a result, South African imports will have to originate elsewhere and under existing circumstances the United States is the logical source from which the Union will have to draw its electrical supplies.

Chemical Engineering Training

In view of the importance of chemical engineering at the present juncture, the Ramsay Laboratory of Chemical Engineering at University College, London, has reopened, and students are being accepted for training in chemical engineering and research.

Prices of Materials

Henry Gardner & Co., Ltd., report, November 1st: Copper bars (best selected) £85, £1 decrease. English pig lead, English block tin, mercury and spelter, no change.

Edward Till & Co. report, November 1st: India-rubber, Para fine, 11½d., ½d. increase.

F. Smith & Co. report, November 1st: No change in the prices of electrolytic copper bars, wire rods and h.c. wires.

All-electric Bakery

An all-electric bakery, in which working conditions have been specially studied, has recently been completed at Chester, where it forms part of the Chester Co-operative Society's premises on the outskirts of the city. It has been designed by the architects' department of the Manchester C.W.S. to harmonise with the model dairy and grocery store close by. Before choosing electrically heated ovens, a

(Continued on page 595)

thorough investigation into the question was made by a committee including Mr. B. Reynolds (president) and Mr. W. Lewis (general manager). Several bakeries in a number of towns were visited and the ovens inspected. Three electric ovens of the peel type in bottle-green vitreous enamel were supplied by the General Electric Co., Ltd., each of the two decks having a "sole" area of 8 ft. by 4 ft. To enable Vienna goods to be produced, one oven has provision for steam injection. Other G.E.C. electrical food production apparatus includes proving cabinets, a large scone plate, two chocolate dippers, a small hot-plate for warming and boiling rings. Electricity is also used for water and space heating. Hot water supplies are provided by a 100-gal. storage heater, while the working temperature is kept at a predetermined level by a thermostatically controlled system supplemented by panel heaters in one section. Acknowledgments are due to Mr. S. E. Britton, the city electrical engineer of Chester, who did much to assist in making a success of the installation.

Battery Price Increase

Siemens Electric Lamps and Supplies, Ltd., announce that as from Monday next, November 6th, the prices of their "Full-o-Power" pocket torch and cycle lamp batteries are to be increased.

Temporary Removal

The offices of the Hackbridge Cable Co., Ltd., have been transferred from 5-7, Lower Belgrave Street, S.W.1, to the company's Kelvin Works, Hackbridge, Surrey.

New Catalogues and Lists

Sun Electrical Co., Ltd., 118-120, Charing Cross Road, London, W.C.2.—The 1939-40 catalogue of "Sunco" electrical appliances for home, office and factory use contains 112 pages devoted to kettles, cookers, water heaters, vacuum cleaners, irons, floor polishers, washers, industrial appliances, &c. Revised prices are given.

A. Reyrolle & Co., Ltd., Hebburn-on-Tyne.—Pamphlet No. 824 giving particulars of the company's improved unit-type metal-clad distribution gear.

H.M.V. Household Appliances, Ltd., Bourne Bridge, Hayes, Middlesex.—A leaflet describing the new No. 2 controlled heat iron.

Siemens Electric Lamps & Supplies, Ltd., 38-39, Upper Thames Street, London, E.C.4.—A 52-page illustrated catalogue (No. 480) of domestic electrical appliances. Also catalogue No. 534 dealing with "Sieray" electric-discharge lamps.

Allen, West & Co., Ltd., Brighton.—Leaflet 1708, describing the type "PBIN" alarm switch.

M.K. Electric, Ltd., Wakefield Street, Edmonton, London, N.18.—The company's 1939-40 catalogue of electrical accessories (128 pages) containing details of many new lines. Also leaflets No. 193-5 giving particulars respectively of new protected iron-clad switch-sockets, iron-clad switch units, and adjustable grid boxes for 5-A standard switches.

Information Department

GENERAL inquiries from readers relating to sources of electrical goods, makers' addresses, &c., are replied to by our Information Department through the post. Inquiries should be accompanied by a stamped addressed envelope.

Our extensive records enable us to reply to most queries, but occasionally we ask for our readers' assistance in tracing names and addresses not known to us. We should be glad to have such information regarding the following:—

TWINDALE lighting fitting.
RUMSEY pump (agent).
NERVO JUNIOR automatic battery cut-out.

Trade Mark Applications

The following are among the recent applications for British trade marks. Objections against any of the proposed marks may be entered within one month from October 25th.

Telecothene. No. 608295. Class 2 (IV). Resins. No. 608296. Class 9 (IV). Electric cables. No. 608297. Class 17 (IV). Electrical insulating materials and electrical insulating parts.—Telegraph Construction & Maintenance Co., Ltd., 22, Old Broad Street, E.C.2.

Stromberg-Carlson (lettering and design). No. 600863. Class 9 (IV). Telephones, telephone receivers and transmitters, electric condensers and repeating coils, radio telephonic and telegraphic receivers and radio telephonic and telegraphic receivers in combination with gramophones.—Stromberg-Carlson Telephone Manufacturing Co., Rochester, N.Y., U.S.A. (British representatives: Stevens, Langner, Parry & Robinson, 5-9, Quality Court, Chancery Lane, W.C.2).

Weeco. No. 605923. Class 9 (IV). Sound recording and reproducing apparatus, public address apparatus; electric and acoustic transmission measuring apparatus, electric meters, photo-electric cells, radio valves, &c.—Western Electric Co., Inc., New York (British representative: F. C. Tomlins, 152, Coles Green Road, Cricklewood, N.W.2).

New Refrigeration Insulation

A PROMISING new class of heat insulating materials, which would seem to be particularly useful where space is limited, such as in refrigerator cabinets for instance, has been termed silica "aerogel." The materials have been described to the American Chemical Society by Mr. J. F. White (Monsanto Chemical Co.), who stated that they were prepared by drying a gel or gelatinous substance in such a manner that the structure of the solid phase remained unchanged. A material of this kind consists, so to speak, of the skeleton of the original colloid.

According to a report in the *Chemical Trade Journal*, when a solution of sodium silicate is added to a dilute acid solution, a silica sol is first formed which soon sets to a silica aquagel which is firm, rigid, and transparent. The concentration can be varied between 3 and 15 per cent. silica, and so the density of the final product can be regulated. If the aquagel is dried by heating at normal pressure, a marked shrinkage takes place, and the final result is a hard glasslike product having about one-fifth the volume of the original gel. A material so prepared is similar to the well-known silica gel employed as a de-hydrator for drying the air which is "breathed" into transformers.

When preparing "aerogel" the water present in the aquagel is replaced by alcohol, in which the gel is placed for diffusion to occur. It is next heated in an autoclave under pressure in excess of the critical. When the critical temperature of alcohol is reached the pressure is reduced to atmospheric pressure, so preventing shrinkage during the drying. A product of low density is thus produced which is made up of a system of pores of submicroscopic size. The pore diameter is thought to be of the same order of magnitude as the mean free path of an air molecule. Therefore the mean free path of enclosed air molecules should be reduced, so that a lesser thermal conductivity than that of still air would be expected.

However, when used substantially above room temperature the mass proved to be pervious to the infra-red wavelength range, and so offered small resistance to heat transfer by radiation. To rectify this deficiency an opacifying agent is added to introduce surfaces for the reflection of radiant heat. Silicon of 98 per cent. purity reduced to 200 mesh by ball milling produces the best results, the optimum amount being 0.75 lb. per cu. ft. of insulation, preferably suspended in the aquasol before it sets into a gel rather than added to the finished "aerogel." It is usual for moisture to condense in or near insulation applied to cold surfaces. "Aerogel" minimises this effect, since it packs in such a way as to reduce air pockets. This prevents connection currents and so also the circulation of fresh moisture-laden air.

Warning to Would-be Exporters

REFERENCE has already been made to the increased interest being shown in export trade by American manufacturers as a result of the difficulties confronting European exporters. This formed the subject of the following racy leaderette in a recent issue of the *Electrical World*:—

Electrical manufacturers with little or no foreign-trade experience are urged to go very slowly in making commitments. The pitfalls are so many that it is not unlikely that nine out of ten inexperienced manufacturers will lose their shirts unless they get help experienced in foreign trade. A large number of new firms have sprung up overnight, both here and abroad, for handling American foreign trade. Most of them, we are informed, are "gyps."

Undoubtedly the war, if continued, is going to bring a heightened foreign demand for American electrical products. Orders from abroad are going to be very alluring. Unless the goods can be shipped without any bad after-effects and the price collected in dollars promptly, there is little use in taking the order. Fluctuating exchange, exchange restrictions, blockades, insurance, English blacklist, credit, are but a few of the problems in to-day's foreign trade. It takes an experienced organisation, and one than can be trusted, to handle business profitably under such conditions.

Furthermore, the manufacturer who is toying with the exciting thought of adventure in foreign trade, a field new and strange to him, will do well to stop and consider what it is that causes cattle to break through fences. Distant pastures always look greener, but the cows usually find it is the same grass as that close to home. The only difference is that they have to go farther for it. With domestic markets reviving as business improves, productive capacity will find an increasingly demanding market in this country.

In 1914, when war broke out in Europe, American manufacturers got themselves all hot and bothered about the possibilities of export trade. They saw the industrial countries of Europe too busy with war to pay attention to foreign commerce. They saw the combatant nations with industrial capacity employed in munitions production and needing consumption and capital goods from the United States. They saw OPPORTUNITY, just like that, spelled out in capital letters. But it wasn't. It all petered out to little or nothing when business in this country got to going good after the 1913 depression. Therefore, American manufacturers should "Stop, Look, Listen" before they rush into an export frenzy.

ELECTRICITY SUPPLY

No Coal Tenders at Glasgow. Bradford and Tynemouth Continue Hire-purchase Facilities. Modified Lighting Schemes Banned.

Barnsley.—SUPPLY TO FARM.—The Electricity Committee is to provide a supply to Sunnybank Farm at a cost of £146.

Bognor Regis.—CHANGE-OVER COMPLETED.—The change-over to AC has now been completed and we are informed by Mr. H. A. Harding, electrical engineer to the Bognor Gas and Electricity Co., that the DC service was disconnected from the station bus-bars last week, after an uninterrupted supply since November 3rd, 1913.

Bolton.—PLEA FOR MODIFIED LIGHTING.—At a meeting of the Town Council on October 25th, Councillor B. Vickers advocated a modified lighting system. "Stampede" regulations should be set aside in the interests of public safety, he said. Alderman Demaine, chairman of the Lighting Committee, said that with the Ministry's permission they could install about 5,000 lamps with a beacon type of light which would show only on the ground.

Bradford.—HIRE-PURCHASE TO CONTINUE.—At a meeting of the City Council last week a recommendation of the Electricity Committee that the schemes for the supply of electrical apparatus on hire-purchase should be continued was approved. Alderman J. W. Longley (chairman of the Committee) explained that the Electricity Department had been placed in a difficult position because, the day following the receipt of Government instructions that municipal undertakings should suspend hire-purchase and the hiring of appliances, Electricity House (a subsidiary of the Yorkshire Electric Power Co., Ltd.) had put in its shop windows notices to the effect that it was prepared to supply any electrical goods on hire-purchase. It also advertised in the Press that it was willing to wire houses on the instalment system without any deposit. The Committee's minute was designed to overcome the difficult position in which the Department had thus been placed. It was not intended to undertake hire only, but solely hire-purchase. Nor did the minute confine itself to vacuum cleaners. It referred in the main to the larger types of electrical appliances, and he reminded the Council that, in view of the restrictions relating to coal supplies, it was probable that both electric and gas cookers would be wanted by the public.

Brighouse.—COMPANY'S OFFER REJECTED.—By 29 votes to three the Town Council on October 25th declined to give further consideration to an offer by the Electrical Distribution of Yorkshire, Ltd., to purchase the electricity undertaking.

Cheltenham.—SUPPLY TO FACTORY.—The Electricity Committee had arranged terms for giving a supply to the Kayte Farm factory, for which purpose it will provide switchgear at a cost of £472.

Coventry.—POWER STATION EQUIPMENT.—The Electricity Committee is applying for permission to borrow £3,520 for equipment for the Longford power station.

Croydon.—NEW SHOWROOMS TO BE COMPLETED.—The Electricity Committee reports that it has given directions for the whole of the new offices and showrooms in Wellesley Road to be completed.

Derby.—LOAN APPLICATION.—In our issue of October 13th we reported that the Town Council proposed to consult the Electricity Commissioners regarding proposed extension schemes estimated to cost nearly £600,000. Mr. F. H. Pooles, the borough electrical engineer, asks us to make it clear that the schemes in question have already been sanctioned, the negotiations being only for confirmation under the Treasury memorandum, and offers from contractors are therefore not required.

Doncaster.—RESTRICTION OF NEW SERVICES.—The electrical engineer has been instructed to limit new services to premises where no other form of lighting is installed, or where special circumstances prevail.

East Ham.—M.D. RATE SUSPENDED.—In view of the possible loss of revenue and the additional expense of purchasing and fixing demand indicators, the Electricity Committee has decided to suspend the maximum demand rate as far as new applications are concerned.

Edinburgh.—STAIR LIGHTING.—A number of Edinburgh councillors have pressed for some form of stair lighting during the "black-out," and the Emergency Committee is considering a method in consultation with the lighting superintendent.

£189,500 SCHEME.—At a meeting of the Public Utilities Committee last week it was agreed to make provision in next year's estimates for an expenditure of £90,000 on part of a scheme costing £189,500 for meeting the demand for electricity in the west of the city. For this purpose the voltage from Portobello will be stepped up from 6,600 to 33,000.

Finchley.—EQUIPMENT FOR WARDENS' POSTS.—The A.R.P. Committee is asking the Electricity Department to quote for the installation of heating and cooking apparatus at wardens' posts.

Gateshead.—TENANTS ASK FOR ELECTRICITY.—The Town Council has received 77 applications from tenants of Council houses asking for the installation of electricity, and the matter has been referred to the North-Eastern Electric Supply Co., Ltd.

DISTRIBUTION WORKS.—The North-Eastern Electric Supply Co. is to erect a sub-station at Old Fold, and proposes to lay underground cables in King Edward Street, Bayfield Gardens, and Duncan Street.

Glasgow.—NO TENDERS FOR FUEL SUPPLIES.—At a special meeting of the Corporation Electricity Committee the convener reported that no offers had been received for the supply of fuel required by the Electricity Department. He also referred to negotiations between the coal sales officer for Scotland, the manager, and the managers of other electricity undertakings on the subject of the dilution of fuel used at generating stations by the use of a proportion of "duff" with "pearls" or other qualities. The town clerk was instructed to inform the Lanarkshire Coal Sales Committee that the Electricity Committee adopted the usual procedure in advertising for tenders for the usual quantity and quality of fuel at the usual time of the year, and to inquire if the Coal Sales Committee could furnish any explanation why no offers were submitted.

EFFECT OF RESTRICTIONS.—During September the consumption of electricity in Glasgow decreased by 6 per cent. compared with September last year, the absence of street lighting accounting for 2 per cent. of the reduction.

Hartley and Wintney.—PUMPING PLANT.—A sewerage scheme entailing the provision of a pump-house and electric pump at Hartford Bridge at a cost of £1,100 has been approved by the Rural District Council.

Ilford.—PROPOSED INCREASE IN CHARGES.—At a meeting of the Town Council last week a sub-committee was appointed to consider a recommendation, based on a report by the electrical engineer, that instead of the 5 per cent. at present added to consumers' accounts 33⅓ per cent. shall be added. Councillor Cooper said that two trading losses had considerably reduced the reserve fund. He also referred to the effects of people leaving the borough since the beginning of the war; in consequence 3,600 consumers had been temporarily disconnected.

Jarrow-on-Tyne.—OVERHEAD LINES.—The Town Council has entered into an agreement with the North-Eastern Electric Supply Co., Ltd., for the erection of overhead lines at West Simonside.

Johnstone (Renfrewshire). — STREET LIGHTING TEST CANCELLED.—Home Office officials were to have inspected the new ultra-violet ray street lighting system but a police message called the test off. Great satisfaction had been expressed by those who had seen the lights.

Kettering.—ELECTRICITY PROFITS.—The Electricity Department made a net profit of £2,009 for the year ended March 31st last, compared with £1,434 in the previous year.

Kingston-upon-Thames.—TARIFF INCREASES.—It was reported at the last meeting of the Council that there was a loss of £2,740 on the working of the electricity undertaking during the past year, and it was decided to make a number of increases in charges. These will include an increase from 3d. to 4d. per kWh in the lighting flat rate and an addition of 10 per cent. to the two-part tariff fixed charge. The heating and cooking rate will be raised from ¾d. to 1d. and the "all-in" rate from 1d. to 1¼d. (with assisted wiring, 1¼d. to 1½d.).

Lichfield.—SUPPLY EXTENSIONS.—The Rural District Council has passed plans submitted by the Trent Valley and High Peak Electricity Co., Ltd., for electricity lines to Pipe Wood, and by the Tamworth District Electric Supply Co., Ltd., for lines to Lonkhill Farm, Statfold.

Liverpool.—LIGHTING SCHEME DISCONTINUED.—On instructions from Whitehall, the use of modified lamp fittings in Liverpool streets has been suspended.

SUB-STATION SITE.—The Electricity Committee has obtained a site for a sub-station in Windsor Road, Huyton.

London.—POPLAR.—The A.R.P. Committee is to install electric cookers on a rental basis at various depôts.

Manchester.—DISPUTE OVER PRICE OF COAL.—A report by the town clerk on the result of a complaint made to the Lancashire and Cheshire District Committee of Investigation regarding prices tendered for the Electricity Department's requirements of coal was recently considered by the Electricity Committee, which instructed the town clerk to take all necessary steps to refer the decision to arbitration by the Central Appeal Tribunal.

1938-39 STREET LIGHTING REPORT.—Public lighting cost the Corporation £189,101 in the year to March 31st last, the total expenditure on electric lighting being £75,900. The number of gas lamps in use at the end of the period was 20,782, and electric lamps 10,426, lighting 797 miles of roads and passages.

DISTRIBUTION SCHEME.—The Electricity Committee is to make application to the Electricity Commissioners for consent to proceed with the replacement of overhead networks on the Blackley and Gorton Mount estates.

Motherwell.—LIGHTING SCHEME DISCONTINUED.—The Corporation Electricity Department's "black-out" lighting experiment carried out in conjunction with the Glasgow office of the British Thomson-Houston Co., Ltd., has been discontinued. The experiment proved successful, motorists finding driving much easier.

Mountain Ash.—PENNY LIGHTING RATE.—For the December quarter the Council has decided to reduce the charge for lighting from 2d. to 1d. per kWh, which is equivalent to a gift of £3,000 to consumers. A similar concession was made in the corresponding quarter last year.

ENGINEER'S REPORT.—The report of Mr. E. W. Jones, general manager of the Electricity Department, for 1938-39 reveals an increase in sales of nearly 7 per cent., making the total 2.8 million kWh (1.9 million kWh at the lighting rate). The Department has a two-part tariff, but sold only 0.1 million kWh on this basis last year. Mr. Jones points out that the scope for the tariff is limited owing to the low flat rates in force and local economic conditions. The fact that a large proportion of the inhabitants benefit from cheap coal explains the low average consumption of electricity per head of 82 kWh; this compares with 76 kWh in the previous year. Revenue amounted to £24,640 (against £23,105) and working expenses were £23,340 (£22,065), leaving a gross profit of £1,300. The undertaking being debt-free, the net revenue amounted to this sum plus income from investments.

Oldham.—SCHEME FOR CENTRAL PREMISES ABANDONED.—For the time being the proposal of the Electricity Committee to build central premises in Union Street has been abandoned.

Rotherham.—LINE CONSTRUCTION.—The Highways Committee has granted permission to Newton Chambers & Co., Ltd., to construct an overhead line between Squirrel Castle and Hudsons Rough, Greasborough. The Electricity Committee is to lay a new feeder to Kilnhurst at a cost of £8,000, including the provision for a sub-station.

POWER TARIFF INCREASES.—Owing to rising costs and expenditure on air-raid protection works the Electricity Committee recommends that the standard prices to power users shall be increased by 10 per cent., including the alternative two-part tariff for electric furnaces and other special tariffs.

Salop.—ELECTRICITY FOR SANATORIUM.—The Health Committee has tried for years to obtain electricity for the Prees Heath Sanatorium which is at present lighted by oil lamps, but had been unable to agree to the terms offered by the supply company. Now the Electricity Distribution of North Wales & District, Ltd., has offered the following terms, which the Committee regards as acceptable: a service contribution of £250; an annual charge for seven years of £26; a payment of £6 per kW of maximum demand; one penny a kWh consumed; and rental of transformer at £9 per annum.

Taunton.—SUPPLY TO HALSE.—The Electricity Committee has authorised the borough electrical engineer to proceed with the scheme for supplying electricity to the village of Halse, at an estimated cost of £1,000, subject to a capital contribution of £400 by a prospective consumer.

Tynemouth.—STEPS TO MINIMISE REDUCTION IN DEMAND.—As the demand for electricity has decreased, with a consequent loss of revenue, the Electricity Committee has decided that the present system of hire and hire purchase should be continued. Also, with a view to increasing the output the electrical engineer has made arrangements for factories using the restricted tariff to continue taking a supply until 5 p.m. instead of 4 p.m. This will have the effect of increasing the amount of electricity consumed without increasing the undertaking's maximum demand charges. The question of revising electricity tariffs has been deferred.

Wolverhampton.—SUPPLY TO ESTATE.—The Electricity Committee is to extend the mains to a new housing estate at Albrighton at a cost of £1,267.

Overseas

France.—SIMPLIFIED PROCEDURE.—The procedure to be followed by the electrical industry in seeking approval for new regulations and orders has been greatly simplified. Formerly it was necessary to submit them to one of three bodies, the Superior Electric Council, the Consultative Hydro-power Committee or the Technical Electricity Commission, but this is now dispensed with, although permanent sub-committees exist from which supply organisations may seek advice. It is provided that the Minister for Public Works may exercise the powers of the three bodies in the making of ordinances. The electrification fund is to be supplied by a tax on the sales of low-voltage energy up to a total of 75 million fr., the remainder of the requirements being met from the Budget.

The fund will continue paying subsidies to rural localities to cover interest and amortisation on their bonded indebtedness for electrification work, but the subsidies are to decrease as the indebtedness drops. Localities, agricultural co-operatives and departments not now receiving subsidies may apply to the fund for them, and the fund is authorised to grant not over 70 per cent. of the total charge to localities, or not over 25 per cent. to departments. Should the amount of subsidies to be paid in this way exceed the income of the fund, all the subsidies are to be reduced proportionally so as to maintain a balance between income and expenditure.

A further section simplifies the rules regarding contracts for electricity supplies. It provides that the contract may be terminated at any time by the consumer, regardless of contractual or legal obligations to the contrary, by simple registered letter. Finally, miscellaneous provisions of the new decree law free the Government of liability to damages in cases of the application of Ministerial decrees ordering the combining of several companies, or the development of hydro-power resources to the disadvantage of present users, provided that in each case the individual companies or the present users be provided with shares in the new company, or supplies of electricity, equal to those they now have.

Latvia.—NEW POWER STATION.—A *Reuter* report from Riga states that the Kegums hydro-electric power station, said to be the biggest building ever erected in Latvia, has begun supplying the capital with electricity. The station has cost nearly £1,400,000 and has a capacity of 70,000 kW.

United States.—WORLD'S LARGEST HYDRO-ELECTRIC PLANT.—Since its seventh large generator was put into regular operation recently, the power plant operating at Boulder Dam in the United States has been the largest of its kind in the world, according to the *Reclamation Era*. The seven large units and one smaller unit give the plant a capacity of 860,000 HP. The Dnieproges station in Russia, previously the largest hydro-electric plant, has a capacity of 746,000 HP. The ultimate capacity of the Boulder Dam plant will be 1,835,000 HP, comprising fifteen 82,500-kVA generators and two 40,000-kVA generators. Another large generator is ready to go into regular service, and two more are being manufactured. The recent extension was hurried to completion to prevent a prospective power shortage in the system of the Southern California Edison Company, which it serves.

TRACTION

L.M.S. Railway.—IMPROVED LIGHTING.—On Monday a new method of blacking-out carriage windows, allowing normal lighting to be used, was tried out on the 4.50 p.m. express train from Euston to Heysham. The system is only practicable with corridor stock, and it is anticipated that in due course all the main-line trains in the country will be equipped in this way. For suburban trains a new method of screening is being tested.

London.—REOPENING TUBE STATIONS.—The London Passenger Transport Board announces that the protective works at closed tube stations are proceeding ahead of schedule and it is now hoped to reopen all the stations except Maida Vale before Christmas.

Newcastle-on-Tyne.—BENEFIT OF ELECTRIC TRANSPORT.—Owing to the fact that the City Council Transport Department still operates trams and trolley-buses in addition to motor-buses the rationing of petrol is not having a serious effect on the city's transport services. Mr. T. P. Easton, general manager of the undertaking, said last week that Newcastle was more fortunate than some areas. Had it not been for the trams and trolley-buses the services would have been in a bad plight.

South Africa.—TROLLEY-BUSES AT PRETORIA.—The change-over to trolley-buses at Pretoria is described by Mr. F. W. Pettipher, traffic superintendent of the City Transport Department, in a recent issue of the *Passenger Transport Journal*. Pretoria, the capital of the Union, has substituted trolley-buses not only for its trams, the last of which were withdrawn in August, but also for some modern oil-engined buses. When the final section is completed there will be 15 miles of trolley-bus route and 34 trolley-buses will be in use.

I.E.E. Papers

PAPERS were to have been read as under at meetings of the Institution of Electrical Engineers up to the end of this year, and copies will be available on or about the dates given. "The Trolley Bus," by G. F. Sinclair, November 9th; "Fluid-filling Media for Electrical Apparatus," by F. Meyer, November 23rd; "Electrically Manufactured Steels," by H. A. Sieveking, mid-November; "Design of a Loud Speaker," by W. West and W. McMillan, December 6th; "Operating Experience with High-Voltage Alternators," by W. D. Horsley, December 7th; "Maintenance of Relays and Associated Equipment," by J. R. Brookman, December 8th; "Applications and Limitations of Inverse-Time Overload Relay to Protection of 11-kV Network," by J. W. Gallop and R. H. Bousfield, December 13th; "Electronic Musical Instruments and Development of the Pipeless Organ," by G. J. Winch, December 21st.

Halling Cement Works

Since the publication in our last issue of the illustrated description of the electrical installation at the new cement works at Halling we have learned that much of the power and lighting installation work was carried out by Barnett & Soans, Ltd., under the supervision of Mr. E. Scherman.

FINANCIAL SECTION

New Companies. Returns of Capital. Debenture Charges. Bankruptcies and Liquidations. Reports of Electrical Companies. Dividend Announcements. Stocks and Shares

New Companies Registered

Reeves & Co. (Birmingham), Ltd.—Private company. Registered October 21st. Capital, £12,000. Objects: To acquire the goodwill and certain of the assets of the business of a manufacturer of and dealer in electrical accessories formerly carried on at Crescent Works, Birmingham, by the late A. B. Reeves as Reeves & Co., and to adopt an agreement with M. I. Reeves and B. W. Reeves. Subscribers: H. C. Chambers, Kerri, Blakesley Rd., Yardley, Birmingham, and A. J. Corbett, 35, Woodlands Rd., Moseley, Birmingham. Solicitors: Pinsent & Co., 6, Bennetts Hill, Birmingham.

Landlines Equipment Co., Ltd.—Private company. Registered October 28th. Capital £4,000. Objects: To carry on the business of manufacturers of and dealers in apparatus for telegraphy, telephony, wireless telephony and telegraphy, broadcasting and television, etc. Directors: Major A. S. Poynton, 77, Kensington Gate, S.W.1, and N. R. Reynolds, 39, Downshire Hill, N.W.3. Secretary: G. Head. Solicitors: N. A. Woodiwiss & Co., 32, Sackville St., W.1.

Maurice End, Ltd.—Private company. Registered October 23rd. Capital, £1,000. Objects: To acquire the business of a dealer in electrical goods carried on by Maurice End, 38, Bishop Road, Prestwich, who is a permanent director. Registered office: 7, Blackfriars Street, Manchester.

David Gamble & Co., Ltd.—Private company. Registered in Belfast October 25th. Capital, £2,000. Objects: To carry on the business of wholesale or retail electrical engineering, &c. Directors: G. Cole, 21, Skegoneill Avenue, Belfast, and T. B. Cole, 324, Ormeau Road, Belfast. Registered office: 5, Donegall Square South, Belfast.

Companies' Returns

Statements of Capital

Anglo-Argentine Tramways Co., Ltd.—Capital, £11,000,000 in 800,000 5½ per cent. 1st preferred and 710,000 6 per cent. 2nd preferred shares of £5 and 862,500 ordinary shares of £4. Return dated August 10th. 640,000 1st preferred, 610,000 2nd preferred and 675,000 ordinary shares taken up. £850,000 paid on 20,000 1st preferred and 150,000 ordinary shares, £8,100,000 considered as paid on the remainder. Mortgages and charges: £70,660 annuity; £4,465,674 4 per cent. 1st debenture stock; £1,733,380 4 per cent. 2nd debenture stock; and £6,000,000 4 per cent. income debenture stock.

Eckington Electric Supply Co., Ltd.—Capital, £5,000 in £1 shares. Return dated August 16th. All shares taken up. £5,000 paid. Mortgages and charges, nil.

Associated Distributors, Ltd.—Capital, £80,000 in 50,000 10 per cent. cumulative preference and 30,000 ordinary shares of £1. Return dated August 10th. 43,400 preference and 30,000 ordinary shares taken up. £57,565 8s. paid (£1 per share on 43,400 preference and 13,332 ordinary and 1s. per share on 16,668 ordinary shares). Mortgages and charges nil.

Mortgages and Charges

H. M. Horton, Ltd.—Particulars filed of £500 debentures, authorised September 25th, 1939, charged on the company's undertaking and property, present and future, including uncalled capital, the amount of the present issue being £200.

F. H. Pride, Ltd.—Debenture charged on the company's undertaking and property, present and future, including uncalled capital, dated September 29th, 1939, to secure £5,000. Holders: Branch Nominees, Ltd.

Jeary Electrical Co., Ltd.—Charge on 12, Errol Street, Finsbury, dated October 10th, 1939, to secure all moneys due or to become due from the company to Lloyds Bank, Ltd., not exceeding £3,500.

Fleet Electrics, Ltd.—Issue on October 16th, 1939, of £500 debentures, part of a series already registered.

Receivers Appointed and Released

Perkins Radio Service, Ltd.—R. W. Rothery, of 9, High Street, Guildford, was appointed receiver on October 17th, 1939, under powers contained in debentures dated August 28th, 1936.

Tunewell Neon & Radio, Ltd.—A. C. Goddard, of 625, High Road, Tottenham, N.17, was appointed receiver on October 17th, 1939, under powers contained in debenture dated January 2nd, 1936.

S. G. Leach & Co., Ltd.—H. A. Hann, of "Ingleneuk," Lynton Road, Hadleigh, Essex, ceased to act as receiver and manager on October 16th, 1939.

Company Liquidations

Vine & Weeden, Ltd., electrical contractors, Percy Street, London, W.1.—The statutory meeting of creditors was held on October 25th when it was reported that the shareholders had previously met and passed a resolution placing the company into voluntary liquidation with Mr. H. C. Treby, accountant, 7, Warwick Court, London, W.C., as liquidator. The statement of affairs disclosed ranking liabilities of £323, and in addition there were cash creditors for £97, who had agreed to waive their claims. The assets were estimated to realise £65, leaving a deficiency as regarded the creditors of £258. The issued capital was £100, and so far as the contributories were concerned there was a deficiency of £358, which, together with the cash claims of £97 now withdrawn, made a total of £455 to be accounted for. The creditors decided to confirm the appointment of Mr. Treby as liquidator of the company.

Edward Trower & Co., Ltd.—Winding up voluntarily. Liquidator, Mr. R. J. Osborne, 1, Guildhall Chambers, Basinghall Street, London, E.C.2.

Rayolite, Ltd.—Winding up voluntarily. Liquidator, Mr. F. E. Bendall, King Edward House, New Street, Birmingham. Particulars of claims to the liquidator by November 29th.

Warren Brothers (Middlesbrough), Ltd.—Particulars of claims by November 25th to the liquidator, Mr. W. W. Sills, 3, Baker Street, Middlesbrough. A declaration of solvency has been made by the directors, and all creditors have been or will be paid in full.

Inwald Glass Co. (London), Ltd.—Winding up voluntarily. Liquidator, Mr. H. H. Marks.

Electro-Horticultural Equipment Co., Ltd.—Meeting November 27th at Eldon Street House, Eldon Street, London, E.C.2, to receive an account of the winding up by the liquidator, Mr. L. N. Coombe. As we reported in our issue of May 5th, the works and business of this company have been acquired by Electrocult, Ltd., of Harpenden, Herts.

Waite & Son, Ltd.—Meetings November 20th at Eldon Street House, Eldon Street, London, E.C.2, to receive an account of the winding-up by the liquidator, Mr. J. J. Baker.

Bankruptcy Proceedings

C. Cakebread, 26, Garnault Road, Forty Hill, Enfield, Middx, maintenance electrician, formerly electrical engineer.—At the first meeting of creditors held on October 25th at 29, Russell Square, London, W.C., the statement of affairs disclosed liabilities of £133 with assets of £16, leaving a deficiency of £117. The debtor attributed his failure to insufficient capital, bad debts and drawings in the absence of profits. The case being a summary one was left in the hands of the Official Receiver as trustee.

J. Gibbons, 176, Abbey Street, Derby, and lately carrying on business at 240, Abbey Street, Derby, radio dealer.—This debtor's public examination was closed on October 24th at the Court House, 20, St. Peter's Churchyard, Derby, when it was reported that the liabilities amounted to £995 and the assets to £22. Debtor attributed his failure to lack of capital and inability to make good amounts due from defaulting hirers of wireless sets.

F. W. Ames, 73, Havelock Road, Bognor Regis, Sussex, and lately carrying on business at 20, Longford Road, Bognor Regis, electrical engineer.—It was reported that an explanation was required regarding deficiencies in the cash account at the adjourned public examination held recently at the Court House, Church Street, Brighton. According to debtor's statement of affairs the ranking liabilities amounted to £333 and the assets to 10s. 6d. The hearing was again adjourned.

E. C. Roqueta (sued as E. Cabanas), radio dealer, Charteris Road, Woodford Green.—The receiving order was made on July 20th at the London Bankruptcy Court upon the joint petition of Hickman (1928), Ltd., and Burt & Vick, Ltd., and the debtor was adjudged bankrupt on August 17th. The proofs of debt included £206 claimed by Hickman (1928), Ltd. The public examination of the debtor was appointed for October 24th, and in the debtor's absence was adjourned *sine die*.

D. E. Chaplin and **H. J. W. Taylor** (F. B. Chaplin), electrical contractors and wireless dealers, 95, Oxford Street, Bilston.—Trustee, Mr. R. K. Clark, 37, Temple Street, Birmingham, Official Receiver, released October 20th.

W. G. Baker (Baker & Co.), radio dealer, 19a, Angel Hill, Bury St. Edmund's.—First and final dividend of 8d. in the £, payable November 8th, at 13a, Great Colman Street, Ipswich.

W. J. Williams, electrical engineer (Williams & Parry), 81, High Street, Pwllheli.—Last day for receiving proofs for dividend November 9th. Trustee, Mr. I. D. Hooson, St. Peter's Churchyard, The Cross, Chester, Official Receiver.

W. T. Dalton, wireless engineer, 62, East Street, Horsham.—First and final dividend of 2s. 5d. in the £, payable at 6 and 7, Old Steine, Brighton.

F. W. Scott, radio and electrical engineer, 106, Leeds Road, Outwood, near Wakefield.—First and final dividend of 4s. 10⅔d. in the £, payable at 13, Burton Street, Wakefield.

Reports and Dividends

Ferranti, Ltd., held their annual meeting on October 25th when Mr. A. Whitaker, who presided in the absence of Mr. V. Z. de Ferranti (the chairman), in reading the chairman's speech, said that the company was doing its utmost in production for national work. Their order book showed a considerable improvement on the corresponding date of the previous year. It was, however, impossible to forecast the future in any way. The company's report was reviewed in our issue of October 6th.

The Carrier Engineering Co., Ltd., held its annual meeting on October 26th when Mr. S. L. Groom (chairman), who presided, said that until last year it had been their practice to pay dividends on the ordinary shares yearly. When they met last year they were unable to recommend the payment of more than 25 per cent., but as the international situation improved they thought it right to pay an interim dividend of a similar amount. Now it was in the interests of shareholders that, for the time being, they should conserve their resources and pay future dividends as the financial position warranted. Only 3½ per cent. of the value of orders in hand at the outbreak of the war had been cancelled. They anticipated that their cash position would remain good, and if it did shareholders could rest assured that an interim divi-

STOCKS AND SHARES

TUESDAY EVENING.

STOCK EXCHANGE markets have come this week under the shadow of the uncertainty felt in connection with possible developments from the Soviet Government. This emphasised a caution which had previously been expressed as to the likelihood of there being important events close at hand. Prices were put down a trifle in certain departments, but amongst those connected with electricity supply and equipment, the movements on balance are upwards. With business so quiet as it is, a very small amount of selling, or of buying, suffices to move a quotation in a manner which normally would be regarded as remarkable, but which nowadays is ascribed, and rightly, to the fact of there being buyers where there are not sellers, or vice versa.

Company Profits and E.P.T.

One of the great unknowns exercising the minds of industrial shareholders is the influence which the 60 per cent. Excess Profits Tax, in conjunction with the higher income-tax, will exercise on company profits and dividends. In the recent reports and accounts of two or three companies, the amounts set aside for taxation were a little breathtaking, and left their mark on the dividends declared. Contrariwise, other companies, J. Lucas among them, have maintained dividends without signs of excessive strain through taxation. Evidently the extent of the liability to E.P.T. depends to a great extent on the "standard" which a company can take for the level above which profits come into the "excess" class. This standard can be determined by taking the profits of 1935 or 1936, or the average of either of those years' earnings, with the profits of 1937. It follows that a company already making profits above those of the 1935-7 period starts under handicap: a drop in the 1938-9 earnings leaves a company free to expand profits up to former levels without incurring E.P.T. To many investors, it is a comfortable consideration that, for a large majority of industrial companies, the position is not very unfavourable.

Profit Standards

To give point to the foregoing considerations, a few examples may be taken at random from among electrical companies. Associated Electrical Industries reports, for instance, showed trading profits of £1,056,000 in 1936; £1,290,000 in 1937; and £1,399,000 in 1938. In this case, the average of profits in 1936 and 1937 is only a little short of last year's earnings. If profits were to remain fairly constant at that level, therefore, the company would apparently incur liability to E.P.T. Any further increase would, of course, be liable to the full rate. The shares have risen 2s. to 39s. 6d. Callender's Cable seems to be an example of a company favourably placed, the 1938 profits being well below the average in 1936-7. In other words, earnings could rise some way before coming into the sphere of E.P.T. operation. Ever Ready profits over the past four years also indicate that the company has something in hand, a consideration which, together with the avid demand for batteries, has assisted in the recent increase in the popularity of the shares. In the manner typical of many other electricity supply companies, Midland Counties Electric profits have been rising consistently from year to year. This has to be counted a mild handicap so far as the operation of E.P.T. is concerned.

Gilt-edged Conditions

Conditions in the gilt-edged market have reached a pitch where few people would be surprised to see the early launching of the first new Government Defence Loans. Bank rate has been reduced to 2 per cent., the rate which ruled for seven years before the increase to 4 per cent. on August 24th last. The reduction is taken as the outward sign that money is once more cheap and plentiful. Apart from a little wavering, the prices of gilt-edged securities have remained firm. They have maintained the dramatic change which came over the market in the earlier part of October. Whether or not the Treasury has been doing a little spade-work in preparing the pitch—and there is no evidence of this—a healthy demand has sprung up both from private investors and from institutions.

The most elementary market psychologist knows that nothing attaches a stockholder more firmly to his investment than a rise in prices; it indicates that other people are anxious to acquire the stock. This may explain why people who were anxious to dispose of stocks when these were unsaleable at the minimum prices, are now content to retain them at much higher figures. Together, these influences have conspired to put War Loan on a 3¾ per cent. yield basis, and to create an atmosphere healthy for cheap Government borrowing. Central Electricity stocks are a point higher.

Price Movements

Prices of Home electricity supply shares are again a little better. Provincial shares are in demand, North Easterns, Midland Counties and Clyde Valley being amongst those that have improved. Metropolitans recovered 2s. to 37s. In the miscellaneous group, Tube Investments stand out with a rise of 3s. 3d. to 84s. 6d., British Insulated at 75s. are 2s. 6d. better. Crabtrees have gained 1s. 9d., Mather & Platt 2s. General Electrics put on 2s. 6d. A number of other shares in this group are up by ⅛ or more. Great Northern Telegraphs, after their drop to 25½, rallied to 27½.

Fashions in Finance

The slogan which bid investment sell its fixed-interest stocks and to buy equities with the money, is by no means so vocal to-day as it was earlier this year. The reason for its reconsideration lies in the uncertainty felt as to the incidence of E.P.T. Statisticians are busily engaged in working out the extent which the tax is likely to affect individual companies. In all the present calculations, however, there lurks an element of doubt, and, as a direct consequence of this, investors are asking for debenture stocks and preference shares. Of the former, the market in electricity prior charges is extremely bare. In the daily list of stocks on offer, published by a firm of Stock Exchange dealers in this market, the choice is almost ludicrously little. Preference shares can be obtained in larger numbers and greater variety, but within the last few business days, a dozen rises in their prices have occurred and yields become, of course, correspondingly reduced.

London Transport "C" Stock

Among the minimum prices fixed at the outbreak of war, the quotation of 65 for London Transport "C" stock remains the only one which is obviously far divorced from reality. Admittedly the price was fixed before the rude shock of the decision to pass the final dividend, leaving the interim dividend of 1½ per cent. to represent the total distribution for the year. But it remains difficult to understand why, in the first place, a stock on which the dividend is influenced by variations in the available earnings, should have been placed in the company of fixed-interest trustee securities for the occasion. That the stock should be left free to find its own level, through the normal operation of supply and demand, is a plea heard with increasing frequency on the part of those who can see no objection to the restoration of a free market in the stock. Under the circumstances, the possibility of any reaction to the Board's annual report, just published, was ruled out.

Deceased Accounts

Executors of holders who in their estates included London Passenger Transport "C" stock, may well resent being asked to list the price of the stock as 65, in such cases as those where the proprietor died after August 24th, when the minimum price was fixed. There is no question as to the stock standing at a false figure, and only the Inland Revenue can possibly benefit through the retention of the present minimum. The stock cannot be sold, because nobody would give 65 for it, nor, so far as can be seen, is there much likelihood of an early advance to this minimum. When the terms are announced of the Government's intentions of payment to the railways while the war is in progress, it will then be easier to arrive at an estimate of the stock's proper value.

B.E.T. Dividend Policy

British Electric Traction deferred stock was marked down 63 points, to 650, on the day after the decision to substitute cash dividends for the stock bonuses distributed regularly for many years past. Regrets are natural enough, for the policy has served stockholders extremely well: incidentally, it has saved them a considerable amount in income-tax, the stock being a particular favourite among payers of supertax. The announcement of policy accompanied the declaration of a 15 per cent. interim dividend, and the statement that, if present conditions continue, the final must also be expected to be in cash.

Financial Section (*concluded from previous page*)

Reports and Dividends—contd.

dend would be declared early next year. The volume of work now in hand was greater than at this time last year.

The British Electric Traction Co., Ltd., has declared an interim dividend on the deferred ordinary stock of 15 per cent., less tax, payable in cash. This compares with 2½ per cent., less tax, last year. If present conditions continue the directors state, it must be expected that the final distribution will be made in cash instead of in the form of a stock bonus. A factor influencing the directors' decision is that an issue of stock can now only be made with the consent of the Treasury and there are no means of knowing whether when the time comes such consent would be given.

Meters, Ltd., are paying an interim dividend of 2½ per cent. (unchanged).

The Calcutta Tramways Co., Ltd., has announced an interim dividend of 2½ per cent. (against 3 per cent.), less tax, on the ordinary shares.

Glenfield & Kennedy, Ltd., have announced an interim dividend of 5 per cent., less tax (same).

The Salisbury Electric Light & Supply Co., Ltd., is paying an interim dividend of 4 per cent. (against 3 per cent.).

Broadcast Relay Service, Ltd., has declared an interim dividend of 5 per cent. on £491,450 ordinary shares (against 5 per cent. on £381,450).

North Metropolitan Power Station Co.—A meeting of holders of 3½ per cent. second mortgage debenture stock, series "B," 1965, was to be held on Wednesday last to consider a resolution sanctioning the consolidation and amalgamation of the £1,000,000 series "B." 1965 stock and the recent issue of £1,700,000 3½ per cent. second mortgage debenture stock, 1965, into one issue. This will be called 3½ per cent. second mortgage debenture stock, Series "B," 1965.

The Anglo-Portuguese Telephone Co., Ltd., is maintaining its interim dividend at 3 per cent., less tax.

The Perak River Hydro-Electric Power Co., Ltd., is paying a first and final dividend of 2½ per cent., less tax, for the year to July 31st (against 6 per cent.).

The Kalgoorlie Electric Power & Lighting Corporation, Ltd., has announced an interim dividend of 3 per cent. (same), less tax at 3s. 6d.

ELECTRICAL COMPANIES' SHARES

Prices, Dividends and Yields

Company	1939 High-est	1939 Low-est	Dividend Pre-vious	Dividend Last	Price Oct. 31	Rise or Fall	Yield p.c. £ s. d.
Home Electricity Companies							
Bournemouth and Poole	68/3	57/–	15	15	57/6	—	5 4 4
British Power and Light	30/9	21/–	7	7	25/–	+1/–	5 12 0
City of London	33/9	23/6	7½	7½	24/–	+6d.	6 5 0
Clyde Valley	37/9	27/6	8	8	33/9	+6d.	4 14 10
County of London	46/9	28/–	10½	10½	36/3	+⅛	5 16 0
Edmundson's :							
7% Pref.	31/6	27/6	7	7	28/–	—	5 0 0
Ord.	27/9	18/6	9	6	23/6	+1/6	5 2 2
Elec. Dis. Yorkshire	41/6	32/6	9	9	35/–	—	5 2 5
Elec. Fin. and Securities	47/9	40/–	12½	12½	40/–	—	6 5 0
Elec. Supply Corporation	51/9	41/–	12	12	41/3	—	5 16 0
Isle of Thanet	20/–	15/–	4	4	15/–	—	5 6 8
Lancs Light and Power	34/6	25/–	7½	7½	27/6	—	5 9 1
Llanelly Elec.	22/6	17/6	5½	5½	18/–	—	6 2 3
Lond. Assoc. Electric	30/–	18/9	7	7	18/9	—	7 9 4
London Electric	34/3	22/6	7	7	25/–	+⅛	5 12 0
London Power Deb. Red.	106½	98	5	5	102½	+1	4 17 6
Metropolitan	51/–	35/–	12	12	37/–	+2/–	6 9 9
Midland Counties	38/9	30/–	8	8	35/–	+1/–	4 11 5
Mid. Elec. Power	41/9	35/–	8	9	36/3	+⅛	4 19 4
Newcastle Elec.	28/9	26/–	7	7	26/3	—	5 6 8
North Eastern Electric :							
Ordinary	32/3	23/6	7	7	27/6	+6d.	5 1 10
7% Pref.	32/6	27/6	7	7	29/–	+1/–	4 16 7
Northampton	48/–	41/–	10	10	42/6	+⅛	4 14 0
Notting Hill 6% Pref. (£10)	12½	11½	6	6	11½	—	5 4 4
Northmet Power :							
Ordinary	46/6	30/6	10	10	36/3	+6d.	5 10 3
6% Pref.	29/–	23/6	6	6	25/6	+1/–	4 14 0
Richmond Elec.	29/–	21/6	7	7	23/9	—	5 18 0
Scottish Power	38/9	28/6	8	8	32/6	—	4 18 6
Southern Areas	22/9	17/–	5	5	17/–	—	5 17 6
South London	30/9	23/9	7	7	23/9	—	5 18 0
West Devon	23/3	18/9	5	5	18/9	—	5 6 8
West Glos	21/3	16/3	2	2½	16/3	—	3 1 6
Yorkshire Elec.	38/6	28/9	8	8	33/9	+6d.	4 14 10
Overseas Electricity Companies							
Atlas Elec.	4/3	1/6	Nil	Nil	1/6	—	—
Calcutta Elec.	39/–	25/–	10*	10*	30/6	+6d.	—
Cawnpore Elec.	34/6	28/3	10	10	28/3	—	—
East African Power	26/3	20/–	7	7	21/–	+1/–	6 13 4
Jerusalem Elec.	24/6	21/–	7	7	21/–	–1/–	6 13 4
Kalgoorlie (10/–)	10/6	9/–	7½	7	10/–	—	7 0 0
Madras	31/–	21/3	8*	8*	21/3	—	—
Montreal Power	35½	30	1½	1½	33	+1	—
Palestine Elec. "A"	29/6	20/–	7½*	5*	21/3	+6d.	4 14 1
Perak Hydro-electric	18/9	13/6	6	2½	19/3	+6d.	2 12 0
Shawinigan Power	24	20	85cts.	83cts.	24½	+1	—
Tokyo Elec. 6%	61	37	6	6	50½	+5	11 8 6
Victoria Falls Power	73/9	60/–	12½	15	68/9	—	4 7 3
Whiteball Investments Pref.	19/6	12/6	7½	7½	12/6	—	12 0 0
Public Boards							
Central Electricity :							
1950–70	112	103	5	5	104	+1	4 16 1
1955–75	115½	104½	5	5	105½	+1	4 14 8
1951–73	106½	101	4	4½	102	+1	4 8 3
1963–93	95½	84	3½	3½	85	–1	4 2 4
London Elec. Trans. Gtd.	88½	83	2½	2½	84	—	2 19 6
London & Home Counties							
1955–75	107½	105	4½	4½	105½	—	4 5 6
Lond. Passenger Transport :							
A	114½	103	4½	4½	104	—	4 6 5
B	117½	102	5	5	103	—	4 17 0
C	83½	64½	4	1½	65	—	2 6 2
West Midland Joint Elec.,							
1948–68	112½	104½	5	5	104½	—	4 15 8
Telegraph and Telephone							
American Tel. & Tel.	206	159	9	9	205	+2	4 7 8
Anglo-Am. Tel. :							
Pref.	101½	82	6	6	85½	—	7 0 4
Def.	23⅜	18½	1½	1½	18½	—	8 2 2
Anglo-Portuguese	24/–	17/6	8	8	17/6	—	9 2 10
Cable & Wireless :							
5½% Pref.	95½	75	4½	5½	84½	+1½	6 10 2
Ord.	55	34	4	4	48½	–1	8 5 0
Income	100	87½	—	—	89½	+1	4 9 5
Canadian Marconi $1	6/–	3/9	—	Nil	6/–	—	—
obe Tel. & Tel. :							
Ord.	31/3	23/6	7½*	7½*	26/3	—	6 0 0
Pref.	26/9	22/6	6	6	25/–	+⅛	4 16 0
Great Northern Tel. (£10)	38	27½	20	20	27½	+2	7 5 6
Inter. Tel. & Tel.	10½	5½	Nil	Nil	6½	–¾	—
Marconi-Marine	30/–	23/–	7½	10	25/–	—	8 0 0
Oriental Telephone Ord.	2½	46/3	12*	12*	2 ⅛ xd.	—	5 4 0
Radio Corpn.	8⅞	5½	8	6	7	—	—
Telephone Props.	14/–	12/9	5	6	13/9	—	8 14 6
Telephone Rentals (5/–)	10/–	7/–	10	10	8/–	+1/–	6 5 0
Western Union	40½	19½	2½	—	40	—	—
Traction and Transport							
Anglo-Arg. Trams :							
First Pref. (£5)	7/6	3/6	Nil	Nil	3/9	—	—
4% Inc.	16	5	Nil	Nil	5½	—	—
British Electric Traction :							
Def. Ord.	1025	515	5	5	650	+63	—
Pref. Ord.	164	130	8	8	140	—	5 6 3
Bristol Trams	52/6	36/3	8	10	39/6	—	5 11 4
Brazil Traction	13	7⅛	$1	50c.	9	–⅜	—
Calcutta Trams	25/6	20/9	8	8	21/3	+6d.	7 10 6
Cape Elec. Trams	18/–	16/9	5	6	17/–	—	7 1 2
Lancs Transport	37/9	27/6	10	10	30/–	—	6 13 4
Mexican Light :							
1st Bonds	25	20	5	5	20	—	—
Rio 5% Bonds	81	47	5	5	55	—	8 9 2
Southern Rly. :							
5% Prefd.	75½	48	5	5	59	–2	8 9 6
5% Pref.	99½	79	5	5	84	+3	5 19 1
T. Tilling	2½	32/6	10	10	35/–	—	5 14 3
Tilling & B.A.	54/6	43/9	10	9*	45/–	—	4 2 3
West Riding	37/9	30/–	10	10	30/–	—	—
Equipment and Manufacturing							
Aron Electricity Ord.	32/3	25/–	15	15	25/–	—	12 0 0
Assoc. Elec. :							
Ord.	45/3	31/3	10	10	39/6	+2/–	5 1 3
Pref.	36/6	31/3	8	8	32/6	+⅛	4 18 6
Automatic Telephone & El.	47/6	39/3	10	12½	40/–	—	6 5 0
Babcock & Wilcox	48/–	37/–	10	12½	40/–	–⅛	6 5 0
British Aluminium Ord.	58/9	48/9	12½	12½	54/6	–6d.	4 11 9
British Insulated Ord.	88/–	72/6	20	20	75/–	+⅛	5 6 8
British Thermostat (5/–)	16/–	12/–	18½	18½	13/3	—	6 14 7
British Vacuum Cleaner (5/–)	22/6	12/6	40	40	12/6	—	—
Brush Ord.	5/9	4/–	Nil	Nil	4/6	+6d.	—
Callender's	92/–	52/6	20	15	60/–	+⅛	5 0 0
Chloride Elec. Storage	82/3	62/6	20	15	3½	—	4 12 4
Consolidated Signal	96/–	75/–	36½	36½	75/–	—	9 14 8
Crabtree (10/–)	25/6	17/6	17½	17½	21/3xd.	+1/9	8 4 9
Crompton Parkinson :							
Ord. (5/–)	21/–	12/6	12½	15	17/6	+⅛	—
E. K. Cole (5/–)	9/–	3/–	10	Nil	4/–	–6d.	—
Elec. & Musical Industries (10/–)	14/9	7/–	5	Nil	7/9	+3d.	6 9 4
Electric Construction	38/6	25/–	12½	13½	25/–	—	10 16 0
Enfield Cable Ord.	58/6	42/6	25	16½	43/9	—	7 8 5
Electrical Switchgear (10/–)	27/–	23/9	16	16	23/9	—	6 14 9
English Electric	36/6	25/–	10	10	31/3	—	6 8 0
Ensign Lamps (5/–)	16/9	13/9	—	25	15/9	—	7 18 3
Ericsson Tel. (5/–)	43/–	35/–	25*	25*	35/–	—	3 11 5
Ever Ready (5/–)	25/–	18/–	35	30	25/–	—	6 0 0
Falk Stadelmann	27/–	17/6	10	6	17/6	—	6 17 2
Ferranti Pref.	25/6	22/–	7	7	22/–	—	6 7 3
G.E.C. :							
Pref.	31/9	26/3	6½	6½	26/3	—	4 19 2
Ord.	82/–	61/3	17½	20	75/–	+⅛	5 4 4
Greenwood & Batley	27/6	22/6	7	15	22/6	—	13 6 8
Hall Telephone (10/–)	22/3	19/3	15	15	18/9	+⅛	8 0 0
Henley's (5/–)	21/–	15/–	20	20	17/6	—	5 14 3
4½% Pref.	23/–	18/9	4½	4½	18/9	—	4 16 0
Hopkinsons	46/3	37/3	12½	15	37/6	—	8 0 0
India-Rubber Pref.	21/3	18/9	5½	5½	18/9	—	5 17 4
Intl. Combustion	120/–	97/–	32½	32½	5	—	6 10 0
J. Lucas	60/–	45/–	15	15	49/–	—	6 3 0
Johnson & Phillips	41/3	32/–	12½	12½	36/3	+⅛	6 18 1
Lancashire Dynamo	72/–	55/–	25	25	55/–	—	9 1 10
Laurence Scott (5/–)	12/–	9/6	15	15	9/6	—	7 18 4
London Elec. Wire	31/6	28/6	12	7½	28/9	—	5 4 4
Mather & Platt	50/–	39/–	13½	13½	44/6	+2/–	6 1 4
Metropolitan Elec. Cable Pf.	21/3	21/–	5½	5½	21/3	—	5 3 6
Murex	85/9	63/9	20	20	77/6	—	5 3 9
Pye Deferred (5/–)	13/9	7/6	25	25	7/6	—	16 13 4
Revo (10/–)	35/6	25/–	17½	17½	25/–	—	7 0 0
Reyrolle	61/–	52/6	12½	12½	53/9	+⅛	4 13 0
Siemens Ord.	26/9	18/9	7½	7½	20/–	+⅛	7 10 0
Strand Elec. (5/–)	5/6	3/3	10	4	3/3	—	6 3 1
S. Smith (1/–)	9/–	6/–	37½	50	6/3	—	8 0 0
Switchgear & Cowans (5/–)	15/–	10/–	20	20	11/3	+⅛	8 18 0
Telegraph Condenser (10/–)	7/6	5/–	5	—	7/6	—	—
Telegraph Construction	2⅛	32/6	10	10	32/6	—	6 3 1
Telephone Mfg. (5/–)	10/–	7/–	9	9	7/–	—	6 8 7
Tube Investments	91/–	72/6	23¾	23¾	84/6	+3/3	5 13 3
Vactric (5/–)	4/3	2/3	10	4	2/6	+3d.	8 0 0
Vickers (10/–)	24/6	14/6	10	10	17/6	—	5 14 3
Ward & Goldstone (5/–)	22/6	19/6	20	20	19/9	—	5 1 3
Westinghouse Brake	54/9	36/–	17½	17½	2	+⅜	8 15 0
Walsall Conduits (4/–)	31/9	21/3	55	55	25/9	+⅛	8 16 0
West, Allen (5/–)	7/6	5/9	7½	10	5/9	—	8 14 0

* Dividends are paid free of Income Tax.

CONTRACT INFORMATION

Particulars of work for which tenders are invited, contracts placed, and building schemes promising work for electrical contractors and traders

Contracts Open

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses. Further details of items marked with an asterisk can be obtained from the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, London, S.W.1.

Argentina.—BUENOS AIRES.—November 28th. Irrigation Department. Generators and switchgear. (T. 28105/39.)*

Australia. — INGHAM (QUEENSLAND). — November 29th. Hinchinbrook Shire Council. Crude oil engine and alternator. (T. 27418/19.)*

BRISBANE.—November 16th. City Electric Light Co., Ltd. Metal-clad switchgear. (T. 24566/39.)*

MELBOURNE.—November 28th. State Electricity Commission of Victoria. Voltage regulating equipment. (T. 25061/39.)* One 1,500-kVA transformer. (T. 28221/39.)*

December 6th. Victoria Railway Commissioners. Two 1,500-kVA and one 750-kVA transformers. (T. 28222//39.)*

Birkenhead.—November 14th. Electricity Department. Cables and meters. (October 27th.)

Birmingham.—December 8th. Electric Supply Department. High-pressure steam pipework and associated valves and drain pipework for four new boilers and two new turbo-alternators at the Hams Hall "B" power station. (October 20th.)

Edinburgh.—November 20th. Electricity Department. One 15,000-kVA, 33/6.6-kV transformer with boosters, one 10,000-kVA, 33/6.6-kV transformer with boosters, and 33-kV, three-core cable and multi-core pilot cable. (See this issue.)

India. — November 8th. Bombay, Baroda and Central India Railway Co. Gas-filled and vacuum tungsten filament lamps. N. Lincoln, secretary, Guildcroft, Epsom Road, Guildford, Surrey.

Ipswich.—November 21st. Corporation. Steel-frame buildings for boiler and turbine house, and a 110-ton and other electric overhead travelling cranes at the new Cliff Quay power station. (October 6th.)

Llandudno. — November 4th. U.D.C. Four electrically driven centrifugal pumps and automatic control equipment for delivering water to two storage reservoirs on the Great Orme. Engineer's Office, Town Hall (deposit £1).

London.—BATTERSEA.—November 22nd. Electricity Department. Electric travelling jib-crane and hopper, weighing tower and rubber belt conveyor. (See this issue.)

Manchester.—November 13th. Electricity Committee. One neutral earthing resistor. (See this issue.)

New Zealand.—WELLINGTON.—November 21st. Public Works Department. Protective relays for 110-kVA transmission lines. (T. 26821/39.)*

December 5th. Fifty 5-kVA transformers. (T. 27809/39.)*

February 13th. Three single-phase transformer units. (T. 28146/39.)* Two 2,250-kVA three-phase boosting transformers. (T. 28144/39.)*

February 20th. Seven single-phase transformer units. (T. 28148/39.)* Four single-phase transformer units. (T. 28147/39.)*

March 26th. Four single-phase transformer units. (T. 28143/39.)*

November 21st. 103 outdoor station lighting fittings. (T. 27805/39.)*

March 12th. 110-kV outdoor switchgear and steelwork. (T. 28145/39.)*

December 5th. 50-kV outdoor switchgear and steelwork for Hangatiki substation and 110-kV outdoor switchgear and steelwork for Ongarue sub-station. (T. 27495/39.)* Four 10,000 kVA transformer units. (T. 27496/39.)*

November 28th. Two 1,500-kVA transformer banks. (T. 27493/39.)*

November 24th. Post and Telegraph Department. Engine-generator set. (T. 27490/39.)*

Plymouth.—November 15th. Electricity Supply Department. Ash disposal plant and auxiliary apparatus. (October 13th.)

Sheffield.—November 7th. Electricity Committee. Auxiliary 11-kV three-phase, 150-MVA switchgear. (October 6th.)

South Africa. — JOHANNESBURG. — November 17th. City Council. 33-kV switchgear and auxiliary plant. (T. 25663/39.)*

November 20th. Railways and Harbours Administration. Superheater elements. (T. 26975/39.)*

CAPE TOWN.—November 15th. Electricity Department. Two mercury arc rectifier equipments. (T. 27601/39.)*

January 15th. Booster pumps, complete with driving motors, &c., and piping, two sets of motor starting and control gear, two 3,300-V iron-clad switchboards, two 380/220-V iron-clad distribution boards and one overhead travelling crane. (T. 27966/39.)*

November 22nd. Electricity Supply Commission. Two 2,000-kVA transformers. (T. 28254/39.) Two 1,000-kVA transformers. (T. 28255/39.)

PRETORIA.—November 9th. Union Tenders and Supplies Board. Battery equipment for the Central Telegraph Office, Bloemfontein. (T. 28028/39.)*

BOTHAVILLE (ORANGE FREE STATE).—November 17th. Municipality. Plant for extensions to the electricity undertaking. (T.28258/39.)*

Southport.—November 6th. Corporation. E.h.v. switchgear. (October 20th.)

Uruguay. — MONTEVIDEO. — November 10th. State Electricity Supply and Telephones Administration. 300,000 metres of telephone cable. (T. 26933/39.)*

Wolverhampton.—November 28th. West Midlands Joint Electricity Authority. Two 2,000-kVA transformers. (See this issue.)

Workington.—November 15th. Electricity Supply Department. One 200-kVA and one 175-kVA transformers. (See this issue.)

Orders Placed

Chelmsford. — Highways Committee. Recommended. Traffic signals in High Street (£453).—Siemens & General Electric Railway Signal Co.

Dundee.—Town Council. Accepted. Multi-core low-voltage paper-insulated, lead-covered and armoured cable.—B.I. Cables (£934); Scottish Cables (£299).

Falkirk. — Electricity Sub-committee. Accepted. Boiler for the electricity works extension (£11,922).—John Thompson Water Tube Boilers, Ltd.

Glasgow.—Health Committee. Accepted. Mobile X-ray unit for the Southern General Hospital (£388).—Victor X-ray Corporation. Apparatus for the X-ray plant at Ruchill Hospital (£162) and a spare X-ray tube (£138).—D. B. Selkirk & Co.

Hastings.—Town Council. Accepted. 110-V secondary battery with trickle charger and motor generator charging plant.—Alton Battery Co.

Water Committee. Recommended. Battery and charging plant for Broomsgrove pumping station (£768).—Alton Battery Co.

Rotherham. — Transport Committee. Accepted. Eight trolley-bus chassis and electrical equipment. — Sunbeam Commercial Vehicles, Ltd.

Contracts in Prospect

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Acton.—Factory in Brunel Road for British Sonceboz Co., Ltd., 79, Gorst Road. Flats (36), Lynton Road; P. Pratt and Blount, architects, 174, High Street. Extensions to factory for V.G. Manufacturing Co., Ltd., 18, Gorst Road.

Ayr.—Workshops and office, West Sanquhar Road, for Scottish Stamping and Engineering Co., Ltd., Neptune Works.

Barnard Castle.—Extensive alterations and additions to St. Peter's School; management committee.

Brechin.—Factory extensions and houses, for Coventry Gauge and Tool Co., Ltd.

Bromley.—Factory, Ashgrove Road; J. C. Anderson.

Bromsgrove. — Additions to motor works, High Street; John Bryant & Sons, Ltd. Houses, Broad Street and Providence Road, Sidemoor; R. E. Griffin.

Chester.—School, for Chester Diocesan Board; J. Saxon, architect, Cathedral Chambers, St. Werburgh Street.

Chesterfield.—Alterations and additions to police premises; J. B. Cutts, architect.

Coalville.—Catholic church and church hall in Forest Road; McCarthy, Collings & Co., architects, Forest Road, Coalville, near Leicester.

Cornwall.—School, Tremorvah Estate, Truro, for E.C.; county architect, County Hall, Truro.

Cumberland.—Shelters at Whitehaven, Workington and Maryport; county architect, 4, Alfred Street North, Carlisle.

Dudley (Worcs).—Rebuilding offices in Garratts Lane, Old Hill, for Tube Fittings, Ltd., Old Hill, Dudley; J. M. Tate & Son, Ltd., contractors, Highfield Road, Cradley, Staffs.

Edgware.—Extensions to Community Centre, for Watling Association (£11,000); Granville Streatfield, architect, 13, New Square, Lincoln's Inn.

Fenton (Staffs).—Warehouse, Barron Street; G. Embrey, Ltd., King Street.

Fulwell (Co. Durham).—Fire station; Bell Bros. (Sunderland), Ltd., West House, Newcastle Road, Sunderland.

Glasgow.—Extension to works in Balmore Road, for A. P. Newell & Co., Ltd., Woodside Engineering Works; Geo. A. Boswell, architect, 255, West George Street. Hospital (£17,000); Board of Glasgow Homeopathic Hospital.

Gloucester.—Rebuilding Theatre de Luxe Cinema, for Odeon Theatres, Ltd.; H. W. Weedon, architect, 94, Colmore Row, Birmingham.

Halesowen.—Houses (33); T. Cooper, builder, Furnace Park estate.

Harpenden.—Extensions to Red House Hospital; secretary.

Hartlepool.—Shelters for the T.C.; borough engineer.

Hastings.—Estate layout, off Bexhill Road, St. Leonards; Bexleigh Estates, Ltd.

Hereford.—Block of offices and flats, Bath Street; C. Booth. Y.M.C.A. hall, Hoarwithy Street; H. A. Thomas.

Hove.—Flats (68), Palmeira Avenue; H. L. Ford. Flats (50), Palmeira Avenue and Holland Road; Thompson & Walker.

Ilford.—Pumping station (£20,000): Ilford and Barking Joint Sewerage Board.

Irvine.—New building at St. Michael's College; principal.

Jarrow (Co. Durham).—Shelters; J. M. Black, junr., contractor, Grange Road West, Jarrow, and Maddison Bros., contractors, Burn Street, Jarrow. Cleansing and decontamination centre; J. Barrow, builder, Northbourne Road, Jarrow. Fire stations for the T.C. in Wood Terrace and Bede Burn Road; borough engineer.

Kenley (Surrey).—Flats, near Godstone Road; H. E. Excell.

Lancashire. — Hospital, Davyhulme; county architect, Preston.

Leeds.—Shops, Dixon Lane, Wortley; A. Maude & Sons, Shapton Lane. Shops, King Lane; Henry Lax, Ltd., Clock Buildings, Harehills.

Lemington.—Extensions to Isolation Hospital; Elcock & Sutcliffe, architects 50, Strand, London, W.C.2.

Lichfield.—Houses (50), Curborough Road, for Hayes Bridge Estates Co., Ltd.; J. T. C. Cole, architect, Central Buildings, Love Lane, Blackheath, Birmingham.

Liverpool.—Extension to motor showroom, Mount Pleasant, for Garlick, Burrell & Edwards, Ltd., 42, Renshaw Street; A. S. Atkinson, architect, 14, Castle

Street. Reconstruction of premises, 40, Hanover Street, for R. Sumner & Co., Ltd., wholesale chemists. Factory premises, 20-22, Benson Street, for Ayrton Graham, Ltd., 24, Benson Street; Kenmure Kinna, architect, 14, Castle Street.

London.—(BRIXTON).—Block of flats, 111-117, Coldharbour Lane, S.W.2; Wates. Ltd., London Road, Norbury.. (BERMONDSEY).—Additions to Ship and Shovel Inn, Great Maze Pond; Barclay Perkins & Co., Ltd. Alterations to Half Moon Inn, Rotherhithe Street; Taylor Walker & Co., Ltd. (STEPNEY).—Block of shops and flats, 397-399, Mile End Road; C. H. Ross Davis, architect, Surbiton.

Manchester.—Printing and publishing works, River Street, Hulme; Apex Publishing Co., Ltd.; Cecil King, architect, 4, Chapel Walks.

Mansfield. — Premises, Littleworth; Mansfield Brewery Co., Ltd. Extensions Hosiery works, Kirkland Avenue; Seal & Turner, Ltd.

Middlesbrough.—Extensions to stores, Linthorpe Road, for F. W. Woolworth and Co.,Ltd., 1, New Bond Street, W.1. Houses, Marton Road; T. J. Day, builder, Marton Road, Middlesbrough. Garage, Trunk Road; Bailey and Son, builders, Denmark Street, Middlesbrough.

Newcastle (Staffs).—Central fire station. Lower Mill House Lane, for the T.C.; S. A. Wilmot, architect, Bournville Estate Offices, Birmingham.

Newcastle-on-Tyne.—Extensions to City Council's car sheds in Westgate Road; R. G. Roberts, 18, Cloth Market, Newcastle.

Old Colwyn.—Lay-out, Aucher estate. Llysfaen; Middleton and Tonge Co-operative Land and Building Society.

Pickering (Yorks).—Houses at Allerston, Middleton, Sinnington and Little Barugh; R.D.C. surveyor.

Preston.—Nurses' home extension, Preston Royal Infirmary, for Board of Management; T. Croft & Sons, contractors, Holme Slack Saw Mills, Blackpool Road, Preston.

Rawtenstall.—Extensions to Rossendale Works, for Howorth & Sons, Ltd.. Rossendale Works, Waterfoot; S. Taylor. Son, and Platt, architects, 74, Manchester Road, Burnley.

Redditch.—Extension scheme at Smallwood Hospital for the Board of Management; Martin & Martin & W. H. Ward, architects, 106, Colmore Row, Birmingham.

Rotherham.—Works extensions, Westgate; Rotherham Steel Strip Co. Works extension, Wortley Road; R. Jenkins & Co., Ltd.

Ruyton (Salop).—Land development, Five Ways; Hall, Wateridge and Owen.

St. Albans. — Houses, Marshalswick Farm Estate; T. F. Nash Homes (St. Albans), Ltd.

Salop.—Elementary and senior schools, Donnington and Albrighton; county architect, Shrewsbury.

Slough.—Factory for Foamite, Ltd., Station Road, Langley.

South Shields. — Decontamination depôt; J. Reid, borough engineer, Town Hall, South Shields. Alterations and additions, Barrington Street, for H. Chapman & Co.; G. R. Smith and Partners, architects, Winchester Street, South Shields. Additions to sawmills at Templetown, for H. Wilson & Co.; F. W. Newby, architect, 10, King Street, South Shields. Miners' Hall, Cambridge Street, for the St. Hilda Miners' Lodge, South Shields; secretary.

Surbiton.—Licensed premises, Cox Lane and Oakcroft Road, for Hodgson's Kingston Brewery Co., Ltd.; J. Hill, architect, 124, Sloane Street, S.W.1.

Sutton Coldfield.—Houses (36), Hamilton Road; British Ensign Builders. Public house, Kingsbury Road; Ansells Brewery, Ltd. Houses (40), near Springfield Road; Shaw & Co.

Taunton.—Extension to Isolation Hospital, Cheddon Road, for Joint Hospital Board; Samson and Colthurst, architects, 1, Hammet Street.

Thetford.—Development of estate, St. Nicholas Street; R. J. Goddard.

Towcester.—Works at Silverstone and Whittlebury, in connection with water supply, for R.D.C.; Pick, Everard, Keay and Gimson, engineers, 6, Millstone Lane, Leicester.

Tunbridge Wells.—Licensed premises, Cambrian Road and Upper Grosvenor Road, for E. H. Kelsey; Philpot and Lovell, architects, 88, High Street.

Tynemouth.—Chapel on the West Chirton estate; W. Stockdale, architect, 73, Howard Street, North Shields.

Wallsend-on-Tyne—Shelters at schools; J. A. Blench, borough surveyor, Town Hall, Wallsend.

West Drayton.—New factory opposite Sipson Corner for Welded Fabrics, Ltd., Bath Road.

Wolverhampton. — Works additions, Stanford Road; S. J. and E. Fellows.

New Patents

Electrical Specifications Recently Published

Compiled by a firm of chartered patent agents. The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (1s. each) can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1937

34663. "Electric follow-up control systems." Vickers-Armstrong, Ltd., and J. P. Watson. December 14th, 1937. (513110.)

34907. "Electric incandescent lamps." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. December 18th, 1936. (513249.)

35743. "Electric tumbler switches." G. H. Scholes & Co., Ltd., G. H. Scholes and F. J. Pearce. December 24th, 1937. (513054.)

36101. "Electric communication systems." Telephone Mfg. Co., Ltd., and F. S. Pearson. December 30th, 1937. (513252.)

1938

3263. "Cathode-ray tubes." General Electric Co., Ltd., and R. H. Craig. February 2nd, 1938. (513155.)

3488. "Television systems." C. L. Faudell, R. E. Spencer and I. J. P. James. February 4th, 1938. (513205.)

4974. "Electron lenses." O. Klemperer and W. D. Wright. February 17th, 1938. (Addition to 480857.) (513157.)

6015. "Control systems for electric motors." British Thomson-Houston Co., Ltd. February 25th, 1937. (513158.)

6144. "Control of synchronous machines." British Thomson-Houston Co., Ltd. February 27th, 1937. (513159.)

6281. "Electron-discharge devices." Marconi's Wireless Telegraph Co., Ltd. February 26th, 1937. (513111.)

6615. "Carrier frequency electric communication, signalling, indicating and remote-control systems." J. L. Hills. March 2nd, 1938. (Addition to 467163.) (513161.)

6773. "Electrical contact making and breaking devices, particularly applicable to weighing apparatus." W. & T. Avery Ltd., and A. E. Page. March 4th, 1938. (513259.)

6844. "Arrangements for switching over from normal to spare amplifiers in electrical signalling systems." Standard Telephones and Cables, Ltd., K. G. Hodgson and A. H. Roche. March 4th, 1938. (513162.)

6893. "Signal-actuated alarm, call, and like arrangements." Marconi's Wireless Telegraph Co., Ltd., and E. E. Zepler. March 4th, 1938. (513163.)

6895. "Power-supply circuit arrangements for radio and like transmitters." Marconi's Wireless Telegraph Co., Ltd., and H. Cafferata. March 4th, 1938. (513164.)

7250. "Interconnecting arrangements for open wire telephone and like lines." Standard Telephones & Cables, Ltd., and A. L. Long. March 8th, 1938. (513165.)

7944. "Electrical connection means of the plug-in type." W. Sanders & Co. (Wednesbury), Ltd., and W. Preston. March 15th, 1938. (513166.)

8085. "Automatic starters for electric motors." Donovan Electrical Co., Ltd., and G. O. Donovan. March 16th, 1938. (513059.)

8297. "Electric motor control systems." British Thomson-Houston Co., Ltd. March 17th, 1937. (513114.)

9341. "Supply systems for electric discharge lamps." British Thomson-Houston Co., Ltd. March 27th, 1937. (513168.)

9418/9419. "Electrical relay device responsive to small changes of a magnitude such as current or voltage." English Electric Co., Ltd., and G. Tilstone. March 28th, 1938. (513066/513125.)

9421. "Electric fuse holders." English Electric Co., Ltd., and C. A. Wilson and A. M. Pooley. March 28th, 1938. (513067.)

9654. "Thermal switch for electric fire-alarm systems." A. Eastwood and T. A. Haigh. March 30th, 1938. (513211.)

9775. "Methods of and apparatus for heat-treating filaments." British Thomson-Houston Co., Ltd. March 30th, 1937. (513214.)

9777. "Apparatus for effecting energisation of an electric circuit with unidirectional impulses." British Thomson-Houston Co., Ltd. March 31st, 1937. (513080.)

9922. "Circuit arrangements for Braun tubes." Leybold und von Ardenne Oszillographen Ges. August 5th, 1937. (513093.)

9959. "Continuous heat-treatment furnaces." Birmingham Electric Furnaces, Ltd., and T. G. Tanner. April 1st, 1938. (513219.)

10013. "Electron-discharge devices for television receiving apparatus." Baird Television, Ltd., A. K. Denisoff and V. A. Jones. April 1st, 1938. (513099.)

10065. "Measuring arrangements for high-frequency currents." Siemens & Halske Akt. Ges. April 21st, 1937. (513135.)

10092. "Telecommunication exchange systems." Standard Telephones & Cables, Ltd., and E. P. G. Wright. April 1st, 1938. (513228.)

10093. "Automatic code senders." Standard Telephones & Cables, Ltd., and E. A. Rattue. April 1st, 1938. (513137.)

10094. "Carrier-wave signalling systems." Standard Telephones & Cables, Ltd., and K. G. Hodgson. April 1st, 1938. (513229.)

10552. "Imitation fuel for electric and like fires." Belling & Co., Ltd., and M. Eastwood. April 6th, 1938. (513284.)

10560. "Telecommunication exchange systems." Standard Telephones & Cables, Ltd., and E. P. G. Wright. April 6th, 1938. (513285.)

10563. "Metering equipment for telecommunication exchange systems." Standard Telephones & Cables, E. P. G. Wright. April 6th, 1938. (513286.)

10564. "Switching means for interconnecting coaxial conductors." Standard Telephones & Cables, Ltd., R. M. Barnard, W. Kram and F. L. J. Jarvis. April 6th, 1938. (513287.)

16190. "Trip-operated mechanism for electric switches." J. A. Crabtree & Co., Ltd. (Schiele Industriewerke). May 31st, 1938. (513143.)

20160. "Time switches for electric-lighting circuits." V. Dewhurst and F. Wells. November 3rd, 1938. (513192.)

26263. "Means for jointing electric current conductors." C. H. Jasper. September 8th, 1938. (513245.)

28999. "Electromotors." R. Avigdor. October 6th, 1938. (Convention date not granted.) (513195.)

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12407. "Electric calculating equipment." Standard Telephones & Cables, Ltd., and E. P. G. Wright. April 1st, 1938. (Divided out of 513228.) (513248.)